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ABSTRACT

The document reviews geography concepts and skills which elementary school children can learn in geography lessons. The study is based on research and evaluation studies with empirical test results and on anecdotal reports of what children have learned. The document is presented in four chapters. Chapter I describes the organization of the study. Chapter II focuses on testing children's basic map knowledge and skills before and after geography instruction. Findings indicate that elementary school children benefit from sequential programs of accelerated instruction in map skills. Chapter III reviews children's conceptual and analytical processes, including vocabulary, reading in geography, and general geographic knowledge. Information is also presented on curriculum evaluation research, sequencing geographic skills, and anecdotal accounts of geography for young learners. The final chapter presents conclusions: children can learn what teachers set out to teach, operate at a much higher conceptual level than is generally believed, and demonstrate aptitude for learning geographic concepts if they are given the opportunity. (DB)

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WHAT CAN CHILDREN LEARN IN GEOGRAPHY?

A Review of Research

by

Marion J. Rice and Russell L. Cobb

ERIC Clearinghouse for Social Studies/Social Science Education
and
Social Science Education Consortium, Inc.
Boulder, Colorado
1978

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PREFACE

In 1975 the National Council for Geographic Education (NCGE) established a Task Force on Elementary and Secondary Education. The prime goal of the Task Force was to examine the elementary school curriculum and the role of geography therein. Four major questions are being addressed by the Task Force:

1. What geographic concepts *should* young children learn?
2. What geographic concepts *do* young children learn?
3. What geographic concepts are young children *exposed* to?

In 1977 the SSEC and ERIC/ChESS published a paper that addressed the first question (Manson and Vuicich, *Toward Geographic Literacy: Objectives for Geographic Education in the Elementary School*, 1977).

This paper addresses the third question, "What geographic concepts *can* young children learn? Authors Cobb and Rice have met the challenge admirably.

As part of its continuing interest in collaborating with professional associations to publish worthwhile products for the education community, ERIC/ChESS has collaborated with NCGE in the development of this paper. We appreciate the authors' efforts and hope that this volume is useful to the field.

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1.0 INTRODUCTION

The NCGE Task Force on Elementary and Secondary Education, with the cooperation of ERIC/ChESS, has undertaken a series of papers dealing with the role of geography in elementary education. In 1977 the projected papers were organized around four major questions:

1. What geographic concepts *should* young children learn?
2. What geographic concepts *do* young children learn.
3. What geographic concepts *can* young children learn?
4. What geographic concepts are young children *exposed to?*

The final phase of the Task Force project will incorporate the answers to these questions into curriculum development.

This paper addresses itself to the third question, "What geographic concepts *can* young children learn?" It was based on the premise that a review of the literature--geographic, educational, and psychological--would provide evidence as to the relationship of such learning variables as age, aptitude, interest, and perseverance to geographic knowledge and skills. Drawing upon studies from three traditions--naturalistic observation, experimental research, and theory--and five traditions in geography (Pattison 1964; Bacon 1959), the authors originally envisioned a four-matrix organization outline.

The literature, however, did not support such a complex organization. Studies dealing with geographic learning have been restricted to a few topics, such as map skills and spatial knowledge, and they do not reflect a coherent body of data in the form of theoretical constructs, learning theories, or geographic traditions. Under these circumstances, the authors abandoned the original attempt to review the literature in terms of a-priori organization and have instead reviewed the literature in terms of the few research studies which are actually available. Some anecdotal reports were also utilized if they identified specific learning outcomes.

In a critique of social studies research in 1950, Carr, Wesley, and Murra included references to such geographic concepts and skills as maps, graphs, time, and place. No separate review was given to geography, although geography was reported in the curriculum by subject for seven

grades (4-12). The authors came to the following conclusion, which also applied to geography: "The social studies offer no clearly discernible order of difficulty, no logical order of learning, no series of progressive laws and principles. The obvious variables are the individual pupils, the class, the content, the teacher, the equipment, and the method" (Carr, Wesley, and Murra 1950, p. 1223).

The research base of geographic education did not improve during the next 20 years. Skretting and Sundeen, in their 1969 critique of social studies education, devoted a separate section to geography. They identified only two activities that looked at geography "with the fresh thought necessary"--that of the High School Geography Project (HSGP) and that of Charlotte Crabtree of the University of California at Los Angeles. They concluded that "unless a great deal more research is activated in this field, geography may continue to flounder" (p. 1232). Skretting and Sundeen evidently were unfamiliar with the work of Blaut at Clark University in place perception, the first report of which did not appear until 1969. The University of Georgia Geography Curriculum Project was just getting under way, with a focus on learning theory applied to curriculum development.

Ten years later the situation is not much different from the pessimistic evaluation of Skretting and Sundeen. HSGP had little or no impact on elementary geography; it did not engender a continued interest in geographic curriculum development, as did the various Schools Council projects in England, nor did it stimulate any programmatic research effort. Both the Place Perception Project studies at Clark University and the curriculum-learning theory studies of the Geography Curriculum Project at the University of Georgia were independently conceived. The rigorously conceptualized structure-of-discipline research of Crabtree with primary children (1968) was followed in 1974 by a more systematic investigation of the skills of hierarchical geographical analysis in second-grade children. Her work, probably the best-researched in geographic knowledge and skills, has been ignored. Although the dominant research interest has been in Piagetian replications of various types of spatial tests, the relationship of performance on these to aptitude for geographic instruction has been assumed, rather than demonstrated.

This review, therefore, will not provide prospective curriculum developers with systematic data relating to developmental knowledge and skills in geography. It will indicate the need for more pragmatic research--a need that has been recognized for years. It will also give examples of what children *can* learn in geography, based upon empirical field testing of experimental curricula. This review also repeats a theme characteristic of the early 1960s--that young children can learn more abstract ideas, content, and skills in geography if these are *taught*. That is perhaps the real challenge to geography educators in the 1980s.

1.1 Selecting Material to Show What Children Can Learn

The authors of this work made a number of false starts, which are described here to help the reader appreciate the particular nature of this review. As indicated in the background statement above, the first approach to be abandoned was the collection of data in accordance with an a-priori scheme of traditions in geography. A second approach tried and subsequently abandoned was an investigation of the extensive literature on children's thinking and concept formation, which includes the 1946 classic of Gesell and Ilg, *The Child From Five to Ten;* Russell's masterly synthesis of the literature prior to 1956, in *Children's Thinking;* and more recent reviews, such as Flavell's summary of "Concept Development" in the 1970 edition of *Carmichael's Manual of Child Psychology*. Since that time, there has been a tremendous increase in the number of research articles about various aspects of children's cognitive, affective, and motor development. An investigation of this literature, notwithstanding its scope, indicated few specific references to geographic concepts and skills. While curriculum developers and researchers in geographic education can make inferences from this literature that are pertinent to their particular interests, it seemed unwise to limit the conclusions from the general literature to what children can learn in geography. Neither did it seem wise to restrict the review to empirical evaluation and research studies.

A third false start that was explored in some depth was the investigation of psychological studies related to geographic learning. Because of the frequency with which developmental tasks, especially those described

by Piaget, are assumed to be antecedent to the skills associated with geographic learning, it seemed logical to follow this approach. Since the concept *can learn* is related to the concept *ability to perform,* it seemed reasonable to ascertain the extent to which an antecedent state, set, attitude, disposition, aptitude, or entry level was related to geographic learning. This approach follows a transfer paradigm: performance of a developmental task, for example coordination of perspective, is predictive of success in a specific geographic task, for example map decoding. This approach was eventually abandoned, however, because it became increasingly clear--at least to these reviewers--that there was little demonstrated relationship between performance of developmental tasks and performance of school geography tasks (see "Spatial Abilities," Section 1.3).

It was therefore decided to take a fresh look at the four questions originally posed: What concepts should, do, and can children learn in geography, and to what concepts are they exposed? What children *should* learn in geography is a normative judgment that must take into account not merely the skills and knowledge of geography but broader educational objectives as well. It was clear that we were not concerned with this question. On the other hand, upon closer examination the other three projected studies did not seem to be as clearly distinguishable as they did when first outlined. What did the tests of geographic learning show? Did they indicate what children *do* learn? Test data results were disappointing. All they seemed to reveal was that children perform with varying degrees of success on a variety of tests that have no particular relationship to specific curricula, learning objectives, or quality of instruction. Since test results frequently reflect low levels of performance, interpretations of tests frequently lead to recommendations to defer instruction until a later time. Certainly this approach would yield little insight into what children can learn in geography under conditions of appropriate instruction.

It was not until this stage of our thinking that serious attention was given to such curriculum-evaluation studies as those of Crabtree, Muir and Blaut, and Hart. If children were *exposed* to such experimental

curricula and *did* learn, the empirical evidence from the match of learning objectives, curriculum, and test results would be the best indication of what children *can* learn. What they *can* learn, it should be emphasized, is not equivalent to what they *should* learn--a question which involves value issues in addition to empirical evidence. It was therefore decided not only to review experimental geography curricula to which children had been exposed but also to provide extensive excerpts of the outlines of these courses in an appendix. This approach seemed more likely to yield some idea of the great variety of geographic learning tasks to which children have been exposed. No claim is made that these examples constitute a comprehensive and sequential geography curriculum for the elementary grades; they merely offer examples of what children can learn when they are taught under proper conditions. In brief, knowledge and skills demonstrated after instruction seem to provide a better indication of what children can do than either developmental research or status testing independent of any specified curriculum.

No attempt has been made to examine commercial courses of study or even experimental curricula--for example, the Providence, Rhode Island, and *Wisconsin Design* material described by Cox (1977)--for which there were no empirical data. The number of elementary experimental curricula for which there are field-test results based on comparison groups or pretest/posttest designs is limited. It was nevertheless deemed desirable to restrict a review of what children *can* learn in geography to research and evaluation studies with empirical test results, and to anecdotal reports of what children have learned. Undoubtedly, they can and do learn much more than is indicated by these studies, because they are exposed to much more.

1.2 Readiness and Curriculum Design

The design of curricula can follow many patterns. One of the most common patterns relies on expert opinion, either that of an individual (e.g., McMurray 1929) or that of an expert committee (e.g., NCSS 1959). In this approach, the credibility of the recommendations depends on the prestige of the individual or collection of individuals rather than on data, even when justified by a philosophic rationale. Among the other

approaches to curriculum design are (1) a utilitarian account of use frequency (Gibbs 1907; Washburne 1923a and 1923b), an approach especially associated with the scientific movement in curriculum development; (2) a consensus based on response to questionnaires submitted to a panel (Bemis 1966); (3) a jury method based on identifying concepts (Ross 1959); (4) a jury method based on identifying generalizations (Johnson 1966); (5) analysis of literature in an attempt to arrive at generalizations, for example the series at Stanford in the late 1950s which dealt partly with geographic content (Geer 1959; Rambeau 1957; Runge 1959); and (6) a structure-of-the-discipline approach, one especially characteristic of the curriculum reform of the 1960s (Crabtree 1968; Rice 1973).

One of the oldest concepts related to curriculum design is *readiness*--a term prominent in the literature of the 1940s and 1950s, as exemplified in *Early Childhood Education,* the 46th Yearbook of the National Society for the Study of Education, Part 2 (1947). Although the term had lost favor by 1972, when the NSSE chose the same title for Part 2 of its 71st Yearbook, the idea of readiness is still closely associated with early childhood education (which has now extended upward from the preschool years to encompass the primary grades, 1 through 3). An examination of both the Jarolimek (1977) and the Michaelis (1976) texts, the two most popular in the field of social studies education, indicates that each devotes a chapter to the relationship between development and learning. While the treatments in both are brief and therefore general, they reflect the view that one of the bases for curriculum design should be knowledge of child development. Michaelis, while acknowledging the grounding of the social studies in the social science disciplines, specifically states that program planning should take into account the foundations of child development and learning that are related to what children are like and what they learn. Because readiness is one aspect of development, it should be related to curriculum design. While the construct of readiness was not originally discussed by the NCGE Task Force, the question "What geographic concepts *can* children learn?" is a readiness question. It thus seems pertinent at the outset to give some attention to the construct of readiness and to place it in the context of curriculum decision making.

This treatment will be brief. For a succinct but more extensive treatment, the reader is referred to the synthesis by Tyler (1969).

The terms *readiness, maturation,* and *development* have nested meanings. Development is the broadest term, signifying both qualitative and quantitative changes over time; it results from the interaction of maturation and experience. Maturation more explicitly results from genetic changes without the intervention of outside experiences. Readiness, on the other hand, is the level at which a specified task may be undertaken; it is usually interpreted to be the mean of the group (Good 1973).

Since the growth of the child-development movement in the United States, as associated with Gesell and Ilg (1946) and Jersild (1947), the chronological age at which certain behaviors appear in children has been interpreted as the optimum time for instruction to be initiated. Before that time, according to the readiness theory, child psychologists believed that learning should be incidental, in an environment which, though it might provide an enriched repertory of experiences, did not include specific efforts to accelerate learning. The concept of readiness became especially identified with reading when Gates (1937) identified the mental age of 6.5 years as the optimum time at which to initiate reading instruction. The theories of developmental psychology inevitably led to justifications for postponing the initiation of instruction, especially as an increasing number of children from poor and ethnic-minority families were entering school with meager experiential backgrounds. Inevitably, the concept of readiness was expanded to include the idea that there was a critical period during which a child could learn most easily. Anderson, in 1947, wrote: "At some levels of development and experience the child is better prepared to acquire a skill than at other levels. The term 'readiness' expresses this quality" (p. 87). While the term fell into disfavor under the influence of the Brunerian concepts of cognitive growth (Bruner 1960), the idea of readiness was still prevalent in such action-oriented groups as the Association for Supervision and Curriculum Development. Writing in 1963, Krogman explained: "Readiness as a whole is a 'ripening,' i.e., an individual potential translated in terms of capacity and ability." There is a time of growth, he

explained, which, if exploited, will lead to a greater learning ability: "readiness implies a 'best-time' for initiating a specific task situation" (pp. 15, 61).

The concept of readiness has been specifically used in reference to recommended programs in geography. The relationship of readiness to postponement was made explicit by Whipple in her 1941 article, "Elements in Geographic Readiness." She constructed a 32-item readiness inventory and received 205 responses from third- and fourth-grade teachers and supervisors. Each of the 32 items was judged to be a disposition or skill prerequisite to geographic readiness by at least 60 percent of the respondents; for some items, the percentage was as high as 98.

Whipple maintained that the teacher could "remove many difficulties by insuring geography readiness on the part of the pupils and by delaying geography instruction until the children are ready for it" (p. 256). Since she exhorted teachers to build items of readiness, her comments might be interpreted to mean that readiness might be defined simply as the initial and beginning stages of geographic instruction. The coupling of the readiness concept with the idea of postponement merely adds to the problem of how to develop readiness.

In articles by Lemley (1953), who recommended a program of geography readiness for children ages five through eight, and DeSart (1961), who outlined a program of geographic readiness for kindergartners, the term *readiness* was used to refer to a preparatory or primary program prior to the initiation of the formal teaching of geography in the fourth grade. Most of the readiness activities recommended did not constitute a systematic program in geography but rather comprised a miscellany of reading, language-arts, science, and environmental concepts and the simple globe, map, directional, and locational skills emphasized in the prevailing texts of the period. Neither DeSart, Lemley, nor Whipple made any attempt to relate readiness to any particular theory of child-development learning.

In contrast, Barton (1953) specifically attempted to draw curriculum implications for geography from developmental theory as reflected in *The Child From Five to Ten* (Gesell and Ilg 1946). Barton abstracted and emphasized those behaviors and skills which appeared to have a geographic

nature, and his specific recommendations reflected the prevailing theories (local vs. distant, familiar vs. unknown, immediate experience, and learning by doing) in elementary pedagogy. He also acknowledged the influence of Lucy Sprague Mitchell and her book *Young Geographers* (1934). Barton's optimistic interpretations of clinical reports about what young children could do, which laid the basis for a comprehensive approach to geography teaching, no doubt owed much to Mitchell's influence.

While the concept of readiness may have encouraged teachers to postpone the teaching of geography, no other writer went so far as Renner of Columbia University, who advocated the postponement of the teaching of geography until the fourth grade (1951). Renner's recommendation reflected an expanding-environment model in which fourth-grade geography deals with the home and community geography, fifth-grade geography with the local community and selected comparative communities, and sixth-grade geography with the county, state, and nation. Renner's paper was read in Chicago at the NCGE meeting and appeared the following year in the *Journal of Geography*. While no particular consequences can be attributed to his recommendation, the reported decline in instruction in elementary geography in the 1950s might have been caused by the association of the concept of readiness with postponement.

The 1960s were nevertheless an extremely exciting decade in American education. Those years saw a new emphasis on cognitive learning, a new concern for the structure-of-the-discipline approach, initiation of an early-childhood push in a variety of federally sponsored programs (among them Head Start, Follow Through, and Title 3 of the Education Act of 1965), and the establishment of research and development centers focusing on early-childhood and elementary education. Secondary and college educational development in the natural and social sciences became primarily the domain of the National Science Foundation.

Although the structure-of-the-discipline approach to curriculum was quickly replaced, except in rare instances, by a concern for affective education and open-classroom experiences, the psychological underpinnings of the period were (and remain) schizoid. On the one hand there was Bruner (1960), who, in a seductively written monograph, added to American

educational cliches the notion that any idea could be taught to any child with appropriate conceptual and methodological adaptations. Bruner gave aid and comfort to the "pushers" and "stimulators"--those who thought that children's intellectual growth was being stunted by permissive, non-content-oriented school curricula. The flurry of curriculum schemes in the mid-1960s which proposed to add new content to the curriculum frequently cited Bruner in justification, in addition to Hunt (1961) and Bloom (1964). And then there was Piaget.

Probably no psychologist has generated as many replication studies as Piaget, or has been so widely quoted in the literature. Hardly any school movement since the mid-1960s has been put forward without genuflection to Geneva. And, as a cursory review of geographic research shows, Piaget has likewise stimulated replication of experiments by geographers. The willingness of experimental psychologists to replicate Piaget's work was undoubtedly stimulated by his prodigious range of laboratory-type experiments that invited replication. The acceptance of his conclusions by educators, among them curriculum developers, is probably related to the fact that his stages of cognitive growth provided a theoretical framework for intellectual development previously lacking in American developmental psychology, which formerly had been based solely on descriptive manifestations of overt behavior.

Most of the Piagetian references in the educational literature amount to no more than name dropping; in many cases, the authors have acquired their understanding of his stages of cognitive development from secondary sources. Such references are nevertheless accompanied by the assumption, explicit or implicit, that these stages are related in a particular manner to school instruction, and that they should not be tampered with by efforts at remediation. Ironically, we find some peculiar cases of intervention strategies' being justified on the basis of Piagetian philosophical underpinnings, which are essentially maturational. However, Elkind, who was one of the respondents to Jensin in the essays *Environment, Heredity,* and *Intelligence* (1969), made it clear that his interpretation of Piaget was that programs of intervention are *not* justified. Rejecting the claims of such intervention advocates as Bloom (1964), Fowler (1969), and Hunt (1961),

Elkind concluded:

> In summary then, the Piagetian conception of intelligence provides no support either for those who advocate formal preschool instruction or for those who argue for new methods and materials to stimulate intrinsic motivation. (p. 187)

Elkind, who belongs to the school which might be called "delayers," cautions against intellectually "burning" children by overexposure.

One of the early critics of the applications of Piaget, in terms of the restrictive implications of his stages for early learning, was Susan Isaacs (1930), an English educator whose preschool work in the 1920s reflected the best of the active-learning movement which was then popular in both England and the United States and which was the precursor of the open-classroom movement of the 1970s. Isaacs's work was a living testimony that, under directed guidance and stimulation, children could achieve tasks earlier than was presupposed by the Piagetian stages. Wann (1962), who belongs to the readiness-through-instruction or "stimulator" school, is essentially Isaacs 30 years later. Aebli (1970) has more recently expressed the view that the psychology of Piaget is basically a genetic psychology, and that therefore the consequences of attempting to translate Piagetian principles into curriculum may be futile because the descriptions of behavior which emerge from the learning tasks are considered natural manifestations of internal tendencies: while they may develop through experience, they are not amenable to specific instruction. Consequently, it is necessary to look elsewhere to find support for geographic curriculum designs that do not reflect a deferment approach to school instruction.

These comments on readiness are not intended to constitute a defense or condemnation of the readiness movement; rather, they have been included in the hope of alerting the reader to the fact that the interpretation of evidence in education, as in any other facet of life, frequently depends upon a broad philosophical framework which is not made explicit. Educators with different perspectives on readiness can look at the same curriculum and test results and draw opposite conclusions about both the findings and the value of the curriculum. The authors of this review, while thay have

tried to be objective, nevertheless belong to the "stimulator" school rather than to the "delayer" school of geographic instruction. This orientation undoubtedly has colored not only their selection of materials but also their interpretations.

1.3 Spatial Abilities

One of the most common types of research in geographic education investigates the development of children's spatial abilities. This research has been stimulated by attempts to replicate the experiments described by Jean Piaget in such seminal works as *The Child's Conception of Space* (1956) and *The Child's Conception of Geometry* (1948). Interest in Piaget's analyses of the ontology of spatial reasoning has produced numerous replication studies (e.g., Laurendau and Pinard 1970; Beilen 1970; Cobb 1977a and 1977b; Miller 1967; Towler 1969; Eliot 1966; Pufall and Shaw 1973) supporting Piaget's observations about the sequential development of children's spatial reasoning. At least two extended reviews of the research on children's spatial cognition are readily available: "Children's Spatial Visualization" (Eliot 1970) and "The Development of Spatial Cognition: A Review" (Hart and Moore 1973). By and large, geographic educators have unquestioningly assumed that the development of spatial reasoning observed in Piagetian-type studies is related to children's abilities to learn geographic concepts and skills.

The relationship between children's spatial abilities as described in the Piagetian psychological literature and geographic learning is, however, by no means clear. Even though many of the Piagetian tasks, such as coordination of perspectives and viewpoints, have an intuitive appeal to geographers as being necessarily antecedent to the interpretation of geographic phenomena, especially in regard to the use of maps, there is little evidence to support this assumption. In writing about Piaget's coordination-of-perspectives task, Eliot concluded: "It remains unclear, outside the context of Piaget's theory, what the three-mountain task actually measures" (1970, p. 269). Aebli (1970), in a critique of Piagetian theory, observed that the results of such experiments were artifacts of the experimental situation, which required the child to operate

in a predetermined framework. He contended that the process of intellectual development associated with school learning could best be studied by teaching rather than by analyzing tasks that simply uncover previous cognitive structures without revealing how those structures are formed.

Blank (1974) similarly criticized the literature on nonverbal concept learning, such as that postulated in Piagetian epistemology, on the grounds that it emphasized the visual recall of objects and did not take into account the mediational role of language. She concluded that experimental modes which attempt to provide data for the analysis of language learning on the basis of visual-spatial cues fail to account for the vital role language plays in the child's cognitive development. Aebli's and Blank's critiques become significant for geographic education when the directive nature of formal schooling is contrasted with the nondirective, clinical setting of much cognitive-developmental research. It is difficult to relate the observations made from developmental research conducted in clinical test modes to the question of what children can learn in structured school settings. The difficulties inherent in attempting to extrapolate from the sequences of instruction recommended in the developmental literature are exemplified in Meyer's hierarchy of map skills (1973). These reviewers strongly agree with the conclusion drawn by Manson and Vuicich in their essay "Toward Geographic Literacy" (1977) that the "links between map skills and spatial cognition have yet to be made explicit."

The authors of this monograph have struggled with the implications of the various spatial cognition studies, such as those reviewed by Eliot (1970) and Hart and Moore (1973). In general, researchers have not attempted to relate performance on spatial-ability tasks to specific geographic learnings or skills. Two exceptions to this generalization are Beilin (1970) and Cobb (1977a and 1977b), who systematically related achievement on such spatial-concept tasks as the coordination of viewpoints to achievement on map-skills tasks. However, the conclusions of these two researchers are somewhat contradictory and inconclusive, in regard to the relationship between spatial cognition and map skills. On the whole, spatial-ability research indicates an increase in performance with age on experimental tasks but does not in any way shed light on the question "What can young children learn?" If anything, the results of the

research on the development of children's spatial concepts are interpreted as justifying the postponement of geographic instruction rather than as supporting the systematic teaching of geographic concepts and skills and of analytic modes of thought.

In contrast to the observations derived from studies of the ontology of spatial concepts and cognition, the conclusions drawn from research employing direct instructional intervention are much more optimistic about the geographic abilities of young children (Crabtree 1968 and 1974; Hart 1971; Imperatore 1969; McAulay 1962c and 1966b). To these researchers it appears that when children are subjected to a planned, systematic program of instruction designed to develop geographic concepts in a clearly structured and sequential fashion, they are able to learn concepts and skills which (or so the psychological literature implies) are beyond their age capabilities. Children's actual performance in instructional settings, rather than their perfromance on developmental tasks, seems to more logically reflect what they *can* do.

Because no clear conclusions can be drawn from the spatial-ability research about what young children can learn in a directive instructional setting, to review that literature--which has already been done (Eliot 1970; Hart and Moore 1973)--would be both superfluous and irrelevant to the focus of this review. Although it should also be noted that a number of writers question some of the basic Piagetian assumptions (see the references to Isaacs, Wann et al., and Kates and Katz in the discussion of anecdotal studies on pages 81-85), it is beyond the scope of this review to provide a critique of that literature. A partial list of authors whose conclusions disagree with those of Piaget is provided by Kates and Katz (1977, p. 61).

1.4 Organization of This Study

The balance of this review of research on young children's geographic learning is divided into two major sections: "Map Skills" and "Conceptual and Analytic Processes." Each section deals first with status studies which describe what children know in terms of the test instruments utilized and then with achievement studies which assess children's performance

after systematic classroom instruction.

Studies of children's map skills probably represent the single largest body of research in geographic education. However, most of these studies are status surveys that do not answer the question of what map skills young children can develop. Some recent studies, among them those of Crabtree, Muir, and Hart, suggest that systematic instruction can be effective in developing map skills in primary-school children--a thesis documented earlier by McAulay and expounded by Mitchell in *Young Geographers*.

A second, more diffuse body of research deals with children's knowledge of geographic concepts and their analytic abilities. Again, status surveys dominate the literature; these confirm what is generally acknowledged: that children do not demonstrate fundamental knowledge of basic geographic concepts. Such curriculum-evaluation studies as those of Crabtree and Imperatore are, in contrast, optimistic about the potential young children possess for higher-level cognitive learning if they are presented with a program of conceptual development through systematic instruction.

Section 3 also contains five brief anecdotal accounts--two originating in work of the 1920s, two others from the 1960s, and one by geographers in the 1970s--which represent optimistic views of what young children can learn.

The appendices contain summaries of the content and sequence of selected geography curriculum projects and the developers' recommendations for desirable content and sequence. Since it is generally assumed that most children are ready for formal geographic instruction by the fourth grade, the emphases is on curriculum models for preschool and primary-age children.

2.0 MAP SKILLS

This section of the review is divided into three major parts: (1) studies focused on testing skills and knowledge before instruction, (2) studies focused on assessing the teaching of map skills, or knowledge after instruction, and (3) studies focused on measuring specific map skills related to the concepts of direction, scale, and time. The first kind of study provides indeterminate performance data without taking into consideration the quality and amount of prior instruction; the second kind of study gives a better measure of what children can learn. A tabular summary of the studies reviewed is included at the end of each part.

Only one general map test study was identified--that of Cox (1977). The work of the Clark University Place Perception Project, which has generated the most systematic research with maps, has been primarily concerned with the relationship of aerial photographic interpretation to map skills, an idea that has been extended to other forms of spatial encounters--enactive as well as iconic, to use the categories of Bruner.

This review does not include map studies made prior to 1968, the year Rushdoony's extensive review appeared in *Journal of Geography* (cf. footnote, Figure 1). Rushdoony found that most map research was short-term, involved only a few classes, did not systematically investigate map-reading variables, and lacked longitudinality. (These strictures are equally pertinent ten years later.) Between 1960 and 1968, he concluded, there was more concern about what children learn as a result of systematic instruction; prior to 1960, map research consisted predominantly of status studies. Rushdoony reported that 21 of the 37 research studies he reviewed involved some measure of experimentation. This emphasis probably reflected the curriculum reform movement of the 1960s, which was based in many respects on the premise that children could understand and work with more content in geography and the social studies than was expected or provided by teachers and syllabi. The decline in support for elementary curriculum development, which reflected a shift in the development priorities of the U.S. Office of Education, is undoubtedly related to the decline in development and evaluation studies in map skills. During the period 1968 to 1978,

the reviewers identified only 20 studies which were particularly concerned with map usage. Consequently, except for the research in mapping from aerial photography stimulated by the work at Clark University, there has been little experimentation with map skills. The Dale (1972) and Pelletti (1973b) studies at the University of Georgia were primarily concerned with the use of maps to decode information rather than with the development of map skills per se.

2.1. Testing Children's Basic Map Knowledge

Map testing (as opposed to teaching children how to use maps) has been systematically pursued by Blaut and his associates in the Place Perception Project at Clark University. Blaut, McCleary, and Blaut (1970, p. 339) assumed, following Tolman (1948), that children form cognitive or mental maps and that a vertical aerial photograph is a type of cartographic map possessing distance and direction. They therefore concluded that an aerial photograph conforms to an iconic or image map, whereas most maps conform to a linguistic-iconic model requiring verbal knowledge of map symbols and conventions. If preliterate children could interpret map photographs without instruction, it might be argued that children have a nascent map-reading ability on entering school which is acquired naturally from their environmental experiences.

To test these assumptions, a sample of 107 first-grade children in Worcester, Massachusetts, were individually administered a series of tests in which 105 of the 107 correctly perceived a vertical black-and-white photograph to be a downward view of a landscape and identified at least two unlike features on it. In the first Worcester test, a low-level aerial oblique color photograph of a small town and the surrounding countryside was used because it was erroneously assumed that such an angle would be needed as a transition to the vertical. Each student was encouraged, within a ten-minute period, to identify as many things as possible by naming and pointing. The second test involved a black-and-white vertical photograph of a residential portion of a town resembling, but not as complicated as, Worcester.

A third Worcester test with 19 students involved converting a vertical photograph into a map (Blaut, McCleary, and Blaut 1970). Each child was asked to identify houses and roads on the photograph. After this was done,

the child was asked to trace in pencil the outlines of roads and houses. When a few had been traced, the photograph was removed and the child was distracted for a minute. Next the child was asked to name the shapes that had been drawn on the transparency and to color the houses (with a red crayon) and roads (with a yellow crayon). Color codes introduced a conventional element to the sign system. The final task required the child to trace a route in pencil that could be followed between two widely separated houses by way of the roads. Sixteen of the 19 first-graders performed the entire series of tasks; the remaining three performed all but the route-drawing task. The investigators concluded that these experiments indicated that first-graders can read iconic maps and provided some evidence that they can deal with rather abstract maps as well. This part of the experiment--from vertical photograph to map construction to tracing a route via streets and roads--appears to conform to a naturalistic sequence related to a first-grader's abilities and experience.

The vertical photographic task was repeated with 20 middle-class Puerto Rican children in Rio Pedras, all of whom were able to name and point to features which they recognized (Blaut, McCleary, and Blaut 1970). Further cross-validation was made with 58 first-grade children in St. Vincent, West Indies, where there was no television and very little opportunity to receive visual stimulation from movies, magazines, or pictures (Blaut and Stea 1971a). Even so, on two map tasks, the mean score was 1.4 correct identifications. In addition to object identification, children were asked to give a synthesis response by giving names to the photograph as a whole and to a cluster of houses. Approximately 64 percent gave acceptable responses to one or both questions. After an additional two-hour lesson, all the children could identify houses, roads, and woodland, and most were able to understand elementary geographic relationships. This experiment, according to the investigators, confirmed that iconic map-interpretation ability can be found even in a population that receives little visual stimulation.

In a later experiment, Blaut and Stea (1974) gave preschool children an opportunity in free play to set up a model macroenvironment using cars, houses, and streets. The location of the toys provided a placement score;

driving a car from one house to another without leaving the street, a maze score; and dialogue with the child ("What is it?"), a verbal score. There was little difference between the maze scores of three-year-olds and those of five-year-olds, though the latter showed some improvement in the position score. The most noticeable difference was verbal--three-year-olds could not explain the model or their behavior as well as five-year-olds. The investigators inferred that while three-year-olds have the ability to represent a cognitive map physically, they lack the verbal ability to describe it. However, Blaut and Stea concluded that "the child is already a mapmaker at the age of three" (1974, p. 9), adding: "We cannot agree with those who, building on Piaget, maintain that a child cannot properly deal with map skills in the primary grades." (The two articles specifically cited by Blaut and Stea were Miller 1967 and Towler and Nelson 1969.) Blaut and Stea's view of early mapping skills was echoed by Hart (1974), one of the participants in the Perception Research Project, who described the play of three-year-olds in dirt with toys as "mapping." Hart believes that the introduction of play procedures (through which a child manipulates the environment) into the teaching of maps would overcome many classroom problems in teaching maps.

The drawing of freehand recall maps by children has been utilized as a testing technique. This technique is assumed to involve not only an understanding of the relationships between distance, direction, and scale but also skill in drawing and understanding map conventions. However, there are no uniform categories for the analysis of such drawings: Lowe (Balchin and Coleman 1973) used a four-point scale (0-3) to measure position, scale, and plan; Klett and Alpaugh (1976) measured three different factors (perspective, scale, and abstraction); Neperud (1977) measured nine factors ranging from isolated elements to map space. There is also no uniformity in the map drawing tasks. In the only longitudinal study (covering a period of four years), Lowe asked children to draw a map from home to school; Klett and Alpaugh asked children to "draw the San Fernando Valley" without additional explanation; Neperud asked children to draw their own neighborhood as they would show it to a new child moving in.

Lowe's results reportedly showed that seven-year-olds found position

easiest, then scale, with the component of plan (overhead view) most difficult. Neperud, who approached the drawing task from the perspective of an art maturationist, found that by the fourth grade children portrayed the neighborhood in terms of an organic pictorial map, and that by the fifth grade the two highest levels--pictorial map and map space--were manifest. He concluded that his findings supported both the Piagetian developmental stages and the notion that only as children develop a level of spatial cognition associated with a coordinated reference system do they begin to employ pictorial or true map space to represent the large-scale environment. He suggested that investigators "must continue to be cautious in their demands of children, lest they do injustice to the outlined developmental sequences" (Neperud 1977, p. 65).

Working from a different perspective, Klett and Alpaugh (1976) did not find such a definite progression in graphic representation and spatial development. They reported that all of their subjects were higher on the abstraction component than on perspective and scale, and that fourth-grade children actually showed a regression on this measure compared with third-grade children in the sample. This finding appears to be consistent with that of Lowe, who found that a spatially gifted group of children started at age seven to understand plan (drawing features as seen from above, rather than from eye level) better than they understand position and scale; they added these later.

In view of the fact that Blaut (1969) demonstrated that first-grade children could construct and interpret a map from an aerial photograph and that children as young as three years understood the functional use of a maze (Blaut and Stea 1974), it would appear that any attempt to make conclusions about the placement of map skills from a freehand drawing test confuses skills of uninstructed cartography with understanding of the functions of a map.

The existence of such confusion was confirmed by the recent research of Cox (1977) with planimetric and plan oblique maps. Cox constructed a 19-item test which utilized both planimetric and plan oblique maps, on the assumption that the plan oblique might project a more realistic image. The items tested eight different categories of skills. The test sample

of 355 students consisted of a cross section of pupils in grades 2, 4, and 6 in Bloomington, Illinois. There was no significant variation by planimetric or plan oblique map; students did as well on either map. Cox also found no significant variations by sex, residence (rural or urban), or previous experience in downtown Bloomington. Results showed no significant variation by grade level for perception of distance, left-right orientation, or perspective ability. Results were inconclusive about perception of area. Significant variation by grade level was found for left-right orientation, orientation conceptualization, time estimation, bar scale, and compass direction. His items on perception of distance and perception of area were deliberately designed, according to Cox, to test Piaget's theory that many map conceptualization skills are developed during the concrete operational stage (ages seven through twelve).

Cox concluded that his findings were in agreement with Piaget's theories about perception of length and area, but only in partial agreement with the latter's theories about perspective ability: "Children as young as seven or eight years seem to be able to make comparisons of length and area at an ordinal level of measurement. . . . This means that the children understand that there are different perspectives or different locations from which to view a building from a view 180° different from that shown on the map" (Cox 1977, p. 131). Cox did not claim that his findings showed that second-graders can coordinate perspectives in the Piagetian sense, or that they have a truly spatial understanding of an entire map. He concluded that the best line of map research was to concentrate on studying "the effects of instruction on children's performance" (a subject reviewed in Section 3.0).

Cox, like Rushdoony (1868), made recommendations concerning a map-skill sequence. However, the two sets of recommendations (described in Appendix A and Appendix B) are difficult to compare. Cox recommended a sequence primarily in terms of cartography, his professional specialty, whereas Rushdoony appeared to relate map skills primarily to geographic information. While these two approaches are not mutually exclusive, they do reflect different points of emphasis and different value judgments about the priorities of school learning. The difference in approach is

also one of scale. A global concern appears much earlier in the sequence advocated by Rushdoony, who introduced globe symbols to four-year-olds; in Cox's work, the word *globe* in not found until the eight-year-old level.

Both Cox and Rushdoony agree that there is a progressive improvement in the use of maps by grade level, that deficiencies in map conceptions are due more to lack of systematic instruction than to lack of aptitude, and that there has been much emphasis on what children actually know rather than on what they might learn as a result of sequentially planned and systematic instruction. The common conclusion that can be drawn from their two different approaches is that although there might be more than one valid sequence in the development of map skills, planned instruction is a prerequisite to performance regardless of the sequence selected.

Only one report recommending a sequence for map-skills instruction for English children was identified (Brown et al. 1970). Brown's recommendations about what children can understand appear unduly restrictive in the light of American research: at age 8, conventional signs and directions; 9 to 10, grid reference, contour lines, and location of individual buildings; 11, scale; 14, interpretation of physical features and settlement patterns.

Most map studies test the performance of children on maps in which design and quality are not variables. The exception to this approach is the cartographic study of Phillips (1973), who designed three types of symbols to test the relationship of design to the comprehension of ten phenomena on maps of three different scales. The three types of symbols were (1) pictorial (highly detailed to suggest three dimensions), (2) semi-pictorial (two-dimensional and in less detail), and (3) abstract (symbols standardized through tradition). The three types of test maps were (1) simple map, large scale, (2) map in somewhat smaller scale with twice as many symbols, and (3) a medium-scale map with a complex highway and river network on which symbols were used a number of times. The tests were administered to about 1,000 children in grades 1 through 6.

The results of this study, according to Phillips, showed that the abstraction level of symbols is related to symbol recognition and achievement and that the symbol recognition and achievement improve from grade to

grade, but unevenly. Phillips noted that the study did not answer questions related to symbol size and design. The fact that he did not hold the map and the test tasks constant (the variation being symbol design) made it impossible to answer what originally appeared to be the major question--the relationship of symbol design to map interpretation. Carswell (1971) takes the position, however, that map design does not have to be radically changed to be interpreted by children; instead, he believes, attention should be focused on better techniques for preparing teachers and teaching map skills to children.

The relation of teacher map knowledge to pupil knowledge was shown by Schneider (1976) in an administration of the Nystrom *Where and Why* 69-item test to a sample of sixth-grade students and to elementary-school teachers. All of the teachers had indicated that teaching map and globe skills was an important instructional objective for them. While pupil performance was dismally low, of particular interest was the performance of teachers. Although their mean score represented a considerable improvement over the scores of the sixth-graders, analysis indicated that many of the teachers had the same problems as the pupils and exhibited many of the same weaknesses. Schneider concluded that if teachers themselves do not have an adequate background, it is not reasonable to expect satisfactory performance from pupils. While there was no significant difference in the mean achievement of teachers based on years of teaching experience, there was a decline in the low score with years of teaching experience--a finding that suggests that a teacher's understanding of map and globe skills does not improve with classroom time. Whether this phenomenon is the result of deficiencies in teacher preparation of of a decline in knowledge that may occur during elementary teaching is not known. It certainly suggests, as Schneider points out, that teachers deficient in map-skill knowledge can hardly be expected to plan appropriate programs and experiences for sequential map-skill achievement.

Figure 1

TESTING CHILDREN'S BASIC MAP KNOWLEDGE

Study and Date	Grade Level	Description of Study	Findings and/or Conclusions
Balchin and Coleman 1973 (work of Lowe)	2-5	Freehand recall map--children were asked to draw route from home to school each year for four successive years. A scale of 0-3 was used to rate growth in comprehension of position, scale, and plan.	Most children reached level 1. For seven-year-olds, position was easiest, then scale, then plan; order of difficulty remained constant over grades 2-5 but quality improved with each grade.
Blaut 1969; Blaut, McCleary, and Blaut 1970	1	Interpretation of aerial photograph; conversion of aerial photo into map. Samples were students living in Worcester, Mass., and Rio Pedras, P.R.	Without instruction, 105 of 107 of students saw aerial photo as downward view of landscape and identified two unlike features; 16 of 19 students converted aerial photo to map using acetate overlay.
Blaut and Stea	1	Cross-validation of the Worcester aerial photo test in St. Vincent, W.I. an isolated peasant community with no television and few other visual stimuli.	Of 58 subjects, 64% gave acceptable answers to aggregate question (name photo and cluster of houses). Mean score of 1.4 correct identifications.
Blaut and Stea 1971	K,2, 4,6	Aerial photo recognition test with students from four grade levels; feature identification only.	K mean was 2.6 correct identifications; grade 2, 4.3; grade 4, 4.8; grade 6, 4.7. Little improvement after second-grade level.
Blaut and Stea 1974	Pre-school (ages 3,4,5)	Toy-play to see if children would set up a model macroenvironment using cars, houses, streets. Placement, maze, and verbal scores were obtained. Ages of subjects ranged from three years to five years and eleven months.	Placement scores improved with age from 7.84 11.41, maze scores improved from 59.1 to 65.5, and verbal scores from 13.6 to 55.2. At age three children could represent a cog-map physically but lacked the verbal ability to explain.

This table of summaries includes studies subsequent to 1968, the year of Rushdoony's map study (*Journal of Geography* 67: 4, pp. 213-222).

Study and Date	Grade Level	Description of Study	Findings and/or Conclusions
Cox 1977	2,4,6	Eight map-conceptualization skills were tested using planimetric and plan oblique maps.	Piaget's theories about perspective were partially contradicted; children as young as seven could perform many map-reading tasks.
Hart 1974	Preschool (age 3)	Observation of three-year-olds at play.	Play in dirt with toys was seen as "mapping."
Klett and Alpaugh 1976	1,3,4	Freehand recall map. Children were asked to draw San Fernando Valley in one class period of 40 minutes; no other instruction. Ho progression in terms of perspective, scale, and level of abstraction by grade.	Abstraction was more advanced at all levels than perspective or scale, with regression after grade 3,
Neperud 1977	1-6	Freehand recall map. Children were asked to draw what they would show a new child in the neighborhood. Nine categories of responses were measured. (This study was done from the perspective of art, not geography.)	Increase in map representation by grade level; highest levels did not appear until fifth grade. Results were interpreted as supportive of Piaget.
Schneider 1976	6, adult	Nystrom *Where and Why* test was administered to samples of students and elementary teachers.	On 69 items, the student mean scores were 31 and 39; teacher mean score was 53. Teachers exhibited many of the same weaknesses that students did. Teaching experience was not correlated with scores.

2.2 Testing Map Knowledge After Instruction

Ten studies were identified since Rushdoony's 1968 synthesis which provide data on teaching with maps and performance on map skills after instruction. Two of these studies are an application of Blaut's hypothesis that aerial photographs constitute an iconic map which can be translated by children into a graphic map (Muir and Blaut 1970; Hart 1971). Five studies made the assumption that mapping is especially significant because maps are central to a depiction of spatial relations, an idea that is accepted as core geographic theory (Coons 1966; Crabtree 1968 and 1974; Hart 1971; Muir and Blaut 1970). There is no common link connecting the other studies. Taken together, however, they reflect a stimulation theme characteristic of earlier studies in the 1960s--that children in the early grades can perform at a higher map-skill level if given the proper instruction. Not only can young learners handle more content, these researchers believe, they can operate at a higher level of abstraction than that found in conventional social studies map programs.

The work of Crabtree was concerned with testing assumptions about the structure of the discipline in a conceptual-inquiry program (1968) and an hierarchy of geography concepts (1974). Although Crabtree's studies are reviewed more extensively elsewhere in this report, some attention needs to be given here to her findings relative to maps. Aerial photographs, maps, and models occupied a prominent place in her instructional strategies because both the 1968 structure-of-the-discipline study and the 1974 study of learning hierarchies involved areal relationships. A substudy showed that second-grade students could learn set-discrimination skills from aerial photo analysis and that second-graders profited from systematic instruction in comparison with a control group instructed only in photo identification.

One of Crabtree's students, Coons (1966), undertook a program to teach second-graders advanced map-reading skills for three main tasks; symbol identification, areal identification, and areal differentiation. These tasks were tested at three levels of abstraction: highly pictorial, semipictorial, and abstract. A *t*-test analysis showed that children made

significant gains in the three operations at all levels of abstraction. No significant difference was found between children's abilities to perform these operations at high and low levels of abstraction. Coons concluded that second-grade children, if instructed in abstract map use, were not restricted to concrete operations. Of the 29 students, 27 (93 percent) achieved a score of 20 or better out of a possible score of 30 at both the pictorial and the abstract levels of symbolization.

A second substudy by Crabtree (1968) with first-grade children involved the use of coordinate reference systems in mapping. The experimental treatment required mapping linear and coordinate relationships from a three-dimensional model. The program was of short duration (two weeks) for 20 minutes per day. This treatment was significant at the .01 level. An interesting finding in the substudy was that there was no statistically significant relationship between perceptual intelligence and mapping, but there was a relationship significant at the .01 level between mapping and verbal intellignece. "Conceptual intelligence, on the other hand," Crabtree observed, "correlated positively with subjects' emergent skills in the conceptual tasks of mapping Euclidean relationships" (1968, p. 108). Anecdotal comments also indicated the relationship of mapping to concepts previously acquired through language. For example, prior knowledge of areal association permitted children to note and perceive patterns of relationship on a field trip without cueing from the teacher (Crabtree 1968, p. 139). Young children may thus profit from instruction in abstract concepts, a point which Savage and Bacon (1969) also made.

The focus of Crabtree's 1974 study was the possibility of defining a latent scale of hierarchical learning around areal association and spatial relationships. While her study was conceptualized in terms of learning hierarchies, task performance required aerial photographic and map analysis. The six-category learning hierarchy (which was subsequently narrowed to five categories by combining levels 4 and 5) consisted of: (1) multiple discrimination (the ability to identify features of the landscape by their functional categories), (2) observation of concepts (the ability to assign geographic features to regional categories), (3) definition of concepts (the ability to make associations between two or more functionally

related features within a region), (4) first-level analysis the ability to determine patterns of areal association in distributions of features within regions), (5) second-level analysis (the ability to determine patterns of spatial interaction of features within and between regions), and (6) inference (the ability to combine and apply these known procedures in order to explain or predict change in transitional urban regions).

The curriculum lasted for 16 weeks, 50 minutes a day. The studies centered on a series of active field-based experiences of the immediate and extended environment, beginning with the children's residential neighborhood and extending to patterns of circulation in the Los Angeles urban complex. Study was made of such urban regions as residential neighborhoods, commercial centers, the central business district, industrial sites, and the harbor area. In addition to field trips, extensive use was made of aerial photographs, data sheets, scale models, and an acetate overlay map system.

Crabtree's work with aerial photographs, models, and maps in a carefully articulated geographic framework is probably the most sophisticated ever conducted in the United States in geographic education. Her 1966-1968 work antedated that of the Clark University Place Perception Project in attempting to relate its premises to teaching core concepts of geography in a systematic manner. One probable reason for the neglect of Crabtree's work is that she began and continued her research within the structure-of-the-discipline framework, which was popular in the early 1960s but which had peaked and waned by the time her final report was issued in 1968. Since that time geographic education, like social studies education in general, has been concerned with priorities other than teaching a school subject in an integrated and systematic manner.

The works of Muir and Blaut (1970) and Hart (1971) are companion studies which grew out of the Clark University Place Perception Project. The most obvious difference between the two studies is that Muir worked with first-graders and used relatively simple aerial photos of a rural environment while Hart worked with third-graders and used aerial photos of a cluttered urban environment. A more important difference is that

the Muir and Blaut study grew out of the assumption that *mapmaking* might be taught to first-graders by means of black-and-white aerial photographs, while the Hart study grew out of the premise that *geographic theory* might be taught to children before the age of ten by means of aerial photographs (Blaut and Stea 1971). The Hart study thus is a study not just of mapping but of spatial relations in a wider geographic context; Hart's work is much more akin to Crabtree's curriculum, although their theoretical postulates differ.

The Muir and Blaut curriculum was administered to two first-grade classrooms in 15 half-hour lessons. Less than ten percent of the time (40 minutes) was devoted to instruction about the nature of aerial photographs, of which three were used. Twenty-seven percent of the time was devoted to legend and scale. The remainder of the time was spent on various exercises dealing with iconic, abstract, arbitrary, aggregate, and invisible map signs and map-sign complexes, with various review exercises. The sequence of the curriculum is described below.

1. Introduction to vertical perspective, using a vertical aerial photograph, 7½" x 9½", black and white, with a scale of 1:2700, showing the school and its environs.

2. Basic map symbolization, by tracing with matte acetate overlay.

3. Legend, using a "dictionary" of symbols pasted on a huge piece of paper on the blackboard,.

4. Drawing an "imaginary" 24" x 36" map using the symbols learned.

5. Reduction in scale, using a 1:5500 print and demonstrating in class with a Polaroid camera, taking pictures from the floor at different heights.

This sequence was followed by review games and reinforcement:

6. Complex symbolization utilizing a 1:11,500 scale map similar to the pretest and posttest map, but not the same, showing small New England towns with rural areas; signs for topographic features.

The pretest and posttest map consisted of a standard 1:24,000 topographic map at a scale of 1:22,000. The test was individually administered and scored on the basis of the number of signs which the children could

recognize. The posttest score showed 78 percent mean correct responses, with a gain difference over the pretest of 54 percent for the experimental group, 5.7 percent for the first-grade control, and 21.3 percent for the second-grade control. The second-grade control group, which had received 18 hours of map instruction spread over the year, began with a higher pretest score of 37.3, while the first-grade experimental group achieved a mean score of 24.4. Nonetheless, second-graders' performance was poorer than that of the experimental first-graders on the posttest.

A second test was also administered to the experimental group with an actual topographic map, the 1:24,000 quadrangle from which the pretest and posttest map had been made. The mean score of this test was even higher than that achieved on the posttest--84 percent correct responses on a 0-12 scale. All but one of the 42 children were able to identify six or more symbols, indicating a fair achievement by almost the entire experimental group.

Muir and Blaut concluded that the curriculum, consisting of a total of seven and a half hours of instruction, had improved the abilities of first-grade students to deal with planimetric signs on a standard topographic map and to respond to the sign system as if it were a true map. In a subjective evaluation of the drawing of a genuine map on the acetate overlay, 9 performed well on all four criteria, 24 performed well on three criteria, and 9 performed less well. The subjective view of Muir and Blaut was that the poor performance of these students was due not to lack of comprehension or skill but to lack of motivation--a critical factor in experimental curricula, and one which often skews results negatively.

The Hart study, "Aerial Geography: An Experiment in Elementary Education" (1971), would have been more accurately entitled "Development of Concepts of Spatial Relations Through Aerial Photographs and Maps," since this phrase describes both the object and the method. After beginning with a simple identification task using a small-scale aerial photograph centered on the school, the curriculum expanded not only in scale but also in complexity of geographic theory. Although a comparison of the verbal test items with the stated purposes of the various lessons

raises questions about the extent to which the tests measure the geographic theory embodied in the lessons, the course of instruction nevertheless follows a sequential and integrating series of experiences not found in the typical social studies text involving "map skills." The geographic theory is illustrated by the aerial photographs and by the suggestions provided to the teachers for doing interpretive map work with students. There were two treatments: in one treatment the children were merely shown aerial photos; in the other, the children were also flown over the area in an airplane. Since the flying experience had no relation to achievement, it may be disregarded except as a motivational factor (Hart 1971, p. 65).

Because of the number of variables examined in the study, the results cannot be summarized briefly. The posttest analysis of three aerial photographs, each at a different scale, indicated that the third-grade students could identify the major categories of macroscale features in an urban environment, maintain interest in unfamiliar environments presented at various scales, and abstract major land uses and place-wholes. Mean scores were better than 50 percent. These results held up in a retention test administered six months after the posttest. Although performance had declined somewhat on one of the three photographs, performance on the two other photographs--presented at a smaller scale than had been used on the posttest--was still significant.

One of the most interesting findings of the test was the pretest-posttest gain in the ability to move from a pictorial drawing to a maplike drawing of the environment. Among the significant changes were these: (1) the base line disappeared and was replaced by an overhead view; (2) features were reduced in size; (3) home features were replaced by a variety of large-scale geographical features; (4) macroscale figures were introduced; (5) isolated elements were replaced by aggregations; and (6) an increasing network development was depicted through connected roads and streets.

Although many pictorial embellishments and frontal views persisted, as Muir and Blaut had found with their first-graders, Hart concluded that the synthesis of a geographic environment, introduced through aerial photographs, could help children organize the world according to a geographical scale at a younger age than that suggested by Piaget in his analysis of

children's drawings. This finding suggests that Neperud's (1977) analysis of children's neighborhood drawings without instruction (see Section 2.1) does not give a representative picture of the skills children might attain in the depiction of map space if they were taught to progress from aerial photographs to planimetric maps.

There was a significant improvement in scores on three of the four map posttests over those achieved on the pretests. (The fourth test involved transfer from an oblique map whose scale was too small to reveal the morphology of the Massachusetts coastline.) On the verbal test, the most improvement (29 percent) was achieved on "size, distance and scale"; the next-greatest improvement (20 percent) on "location and direction"; and the least (7 percent) on "geographical relations and distribution." Although the last category represents a more abstract level and thus is more difficult for young learners, as Crabtree (1968) found, the lower performance on this part of the test may also have reflected the teaching procedures. According to Hart, "It is necessary for the child to extract the features of the environment visually before he can operate on them verbally" (p. 63). While the course attempted to operate on both visual and verbal conceptions, it is possible that its approach--which was based on the idea that concept follows percept rather preceding it--had some effect on the outcome. Nevertheless, the fact that performance on the progressive tests was not correlated with reading ability suggests that the procedure was helping students who would normally have difficulty reading to learn geography. There was, nevertheless, a relatively high correlation of mental ability, as measured by the Otis Lennon test, with both posttest and delayed posttest photographic achievement.

Another finding was that knowledge of cardinal directions was not necessary for orienting aerial photographs; regardless of how the photographs were handed out, the children, without instruction, were able to orient them properly. In terms of photographic features, low-altitude, large-scale photographs were easier for third-grade children to use than high-altitude, small-scale photographs. (It might be noted that this is equally true for adults, who often require magnifying glasses to identify the detail in small-scale maps.)

Hart concluded that his study indicated that aerial photographs were useful in helping children organize an understanding of their world. Since maps are not used in a systematic manner in elementary grades, he observed, "percept is added to percept in an endless boring chain until some notion of spatial order is evident and the bonds behind these percepts are revealed to the child" (p. 68). The Hart study presents further evidence that children can achieve at a higher level than is normally assumed in elementary instruction, provided that they are given proper perceptual tools and conceptual instruction.

Although Beilin (1970) began with Piaget's theory of development and used six Piagetian spatial tasks, her study qualifies as a teaching study because the children she tested in grades K, 2, and 5 were actually taught map skills through the use of the well-known *Rand McNally Handbook of Map and Globe Usage* (Harris 1967). The relationship of map skills to spatial tasks was tested by correlating the achievement of children on spatial tasks to their achievement on a series of map tasks.

Beilin's reported results are somewhat equivocal in terms of conformity to Piagetian theory. Specific relationships between spatial concepts and map skills showed an uneven pattern. Some relationships--for example, that between the concept *linear and circular order* and the skill *using lines of latitude and longitude* were highly evident; on the other hand, the concept *perspective* was found not to be related to any map task in the study (see Crabtree 1968). The scalability of the six tasks did not reach criterion level. However, when the sets of six tasks were reduced to sets of three, they were reliably ordered. Beilin concluded that her data confirmed the developmental stage sequence described by Piaget and discomfirmed the sequence of objectives described by the *Rand McNally Handbook*--a curious conclusion, in view of the fact that Beilin also reported that the map tasks were much less difficult for the children than the spatial tasks.

Beilin also noted that the variability of achievement within each age group on spatial tasks indicates the difficulty of ordering any kind of map sequences solely by reference to a scheme of intellectual or cognitive development, as Meyer (1973) purported to do in her review of the relationship of psychological research to map teaching. If some map skills

appear to be highly related to spatial abilities and others appear to involve primarily cognitive capacities, it would seem that Beilin's caveat is well taken. The fact that children can perform map tasks after instruction, prior to the emergence of assumed prerequisite spatial abilities, emphasizes the dubious merit of tying map curriculum suggestions to a psychological order of learning.

In this respect, it is interesting to note that geography researchers who have evaluated performance after instruction--for example, Crabtree, Muir and Blaut, and Hart--have tended to emphasize Brunerian constructs of spatial learning in preference to those of Piaget. This was also true of Smith (1972), who set out to construct three curricula in conformity with Bruner's three modes of spatial learning: enactive, iconic, and symbolic. Smith's symbolic curriculum consisted of materials presented entirely by means of language and nonrealistic symbols. The iconic curriculum included language, use of the *Vine Quadrangle* map in Tennessee, symbol sheets for topographic maps, drawings of physiographic features of the environment, and slides of the map area. The enactive treatment included the topographic map and symbol sheet and observation of the target terrain on site.

Smith found that all three treatment groups were superior to the control group, $p<.05$. Although the enactive treatment was not superior to the combined iconic and symbolic treatments on the total score, it was superior on three subscales (distance, size, and shape) and on slides of the area which were unfamiliar to all students. The iconic group was superior to the symbolic group on total scores and on the map symbol and direction subscales. Smith concluded that an optimum map instructional program might combine the enactive and iconic modes. He speculated that use of the iconic mode for the introduction and teaching of basic map symbols, followed by an enactive trip to the area being studied, might produce higher scores than any of the instructional treatments used.

It would appear that both the iconic and enactive modes described by Smith were mixed modes. The iconic mode used language and a variety of conventional symbols for topographic map interpretation; the enactive mode did not rely solely on a field trip, but also used the typographic

map and symbol sheets. (Presumably, it also used language.) As described, the so-called symbolic curriculum would not appear to be useful in good classroom teaching if the ability to use topographic maps were an objective. The study nevertheless indicated that systematic instruction does facilitate the map achievement of fourth-grade students and that fourth-grade students can be taught to use topographic maps--a skill which is made more meaningful by a field trip to the area being studied. Apart from the Brunerian terminology, such procedures simply conform to long-established procedures for making map learning more meaningful.

Topographic maps were also utilized by Carswell (1971) with Canadian students in grades 4, 5, and 6 to teach symbol recognition, determination of direction, scale, elevation, grid location, and map interpretation. The experimental group, which received a program of instruction, performed at a significantly higher level than the uninstructed control group on both the posttest and the retention test. In terms of map skills, symbols and directions were the least difficult while map interpretation was the most difficult--a not unexpected finding in view of other research, particularly that of Savage (Savage and Bacon 1969), who successfully taught map symbols to first-grade chilfren. The differences in performance by grade level, which were depicted in graphic form, were not discussed in Carswell's study. His main conclusion was that emphasis should be placed on training teachers and students in the use of maps in functionally appropriate programs rather than on changes in map design.

Another study at the first-grade level, by Savage and Bacon (1969), focused on the comparison of two different methods of teaching map symbols: concrete and abstract. This study is especially pertinent because its findings suggest that undue emphasis on using concrete methods with young learners is not only unnecessary but actually uneconomical in terms of the ratio of time to achievement. While there was no significant difference in the results by treatment, the concrete method of teaching required six sessions of 30 minutes each, as compared with three lessons of 30 minutes each for the abstract method. There was thus a significant saving in time--children in the abstract group required only half as much time to attain a similar level of performance.

Designed to implement Tabaroff's suggestions for "Improving the Use of Maps in the Elementary School" (1961), Savage and Bacon's concrete treatment involved study of a large (3' x 3') aerial photogaph of a small community, reconstruction of the photograph on the floor of the classroom using blocks, substitution of pictures for blocks, replacement of pictures with map symbols, use of abstract symbols on projected maps, and drawing individual maps using the symbols learned. The abstract treatment began by asking students to note how objects in a room might look from above and progressed to introduction to pictorial symbols, placement of pictorial symbols with map symbols, use of symbol flash cards for review, overhead projection of map with abstract symbols, discussion, and drawing individual maps using the symbols learned. The criterion test, individually administered, required a pupil to point to a symbol as it was called for. There were 16 symbols in conventionalized map form. The ranges of scores were 11 to 15 in the concrete group and 6 to 15 in the abstract group; 13 of the 19 pupils in the concrete group and 15 of the 20 in the abstract group had scores of 14 or better.

The investigators concluded that the research confirmed the results of previous studies which showed that first-grade children could learn on a more abstract level. They also inferred that there may be an undue emphasis in the primary grades on the manipulation of concrete objects as a prerequisite to geographic learning. (Four of the students in the abstract treatment groups were students from low socioeconomic areas who were bussed to the school; no such students were in the concrete group. The mean score of these four students was 9.25; the mean score for others in the group was much higher. Such children, Savage and Bacon pointed out, might require more concrete experiences.)

In contrast to the short treatment which characterized most of the studies, the map treatment of Stoltman and Goolsby (1973), which was part of an individualized reading skills and social studies curriculum, extended over a six-month period. The title of the principal experimental material was *Reading About Sites, Routes and Boundaries*. The map treatment consisted of short content passages interspersed with maps, followed

by multiple-choice exercises which required the third-grade students to use maps in a functional manner. Instead of being isolated, the questions were functionally related, forcing the students to use the maps to answer a definite problem--for example, finding the best route in a city between home and an amusement park.

The criterion measure was the map subtest of the *Iowa Test of Basic Skills (ITBS)*, which was administered as both a pretest and a posttest. There were fourteen classes in the control group and eight classes in the comparison group; all were from a rural county in central Georgia. On the posttest administration of the map subtest of the *ITBS*, experimental-group achievement was significantly higher after adjustment for covariates ($p < .05$). (The covariates were the *Otis Lennon Mental Ability Test* and initial *ITBS* vocabulary and reading scores.)

The treatment appeared to be somewhat more beneficial to the black students, as judged by grade-equivalent gain scores; the grade-equivalent gain of the black students in the experimental group (.53) was almost triple that of the black students in the control group (.19). White students made grade-equivalent gains of .70 and .40 respectively.

Stoltman and Goolsby made no claim for the novelty of the material used, but simply pointed out that systematic map instruction, used in connection with a reading program, raises achievement level in map skills. Although not all the maps used in the study were specifically described, the example given was an abstract spatial-relations map. The findings suggest that using such maps is within the capabilities of both average and below-average students when the maps are presented in a sequential manner.

Figure 2

TESTING MAP KNOWLEDGE AFTER INSTRUCTION

Study and Date	Grade Level	Description of Study	Findings and/or Conclusions
Beilin 1970	K,2,5	Compared suggested sequence in *Rand McNally Handbook of Map and Globe Usage* with six Piagetian tasks	Confirmed Piaget developmental sequence; disconfirmed *Rand McNally Handbook* sequence. Map tasks were less diffucult than spatial tasks. Content for map skills should not be entirely related to a model without empirical testing.
Carswell 1971	4,5,6	Used topographic map (scale 1:50,000) to test symbol recognition, direction, scale, elevation, grid interpretation.	Experimental group performed significantly better; symbols and directions were least difficult; map interpretation was most difficult. Emphasis was on testing instruction, not map design.
Coons 1966	2	Tested advanced map skills: symbol identification, areal identification, and areal differentiation.	Significant gains in the three operations occurred at all test levels: highly pictorial, semipictorial, and abstract; 93% of students achieved score of 20 (of 30) on both pictorial and abstract operations.
Crabtree 1968	1,2,3	This concept-inquiry curriculum emphasized areal association and regional analysis as core geographic theory. Substudies of set discrimination (from aerial photos) and coordinate reference systems were used.	Grade 2 children learned set-discrimination skills from aerial photos; grade 1 children's use of coordinate reference system was significant at .01 level; no relationship was found between perceptual intelligence and mapping.
Crabtree 1974	2	Tested hierarchical structure of learning growing out of regional areal association; extensive use was made of study trips, aerial photos, data sheets, scale models, map-acetate overlays.	No separate findings reported for specific map skills, as in 1968 study; Pr=1.00 for multiple discrimination and .60 for analysis, only .15 for inference.

Study and Date	Grade Level	Description of Study	Findings and/or Conclusions
Hart 1971	3	Tested a 7-week, 16-hour curriculum that was connected and sequential in teaching concepts of boundary, area, place (cities, towns, villages), and centrality. Students used map transparencies from aerial photographs.	Grade 3 students interpreted macroscale features in an urban environment and improved map-drawing skills. Airplane flight affected motivation but not performance.
Muir and Blaut 1970	1	Experimental treatment of 8 hours, 45 minutes, with 9% spent on aerial photo; 27% on legend and scale; remainding time on iconic, abstract, arbitrary, aggregate, and invisible map sign complexes.	Posttest gain difference over pretest of 54% for experimental group, 5.7% and 21.3% for control groups with some map experience in social studies.
Savage and Bacon 1969	1	Comparison of concrete and abstract treatments for teaching map symbols	No significant difference found in effectiveness of treatment; however, abstract treatment took half as long. (Implication is that first-grade children do not need as much concrete emphasis; more verbal instruction saves time.)
Smith 1972	4	Three different treatment groups and three control groups were compared. The three treatments were symbolic (language and nonrealistic symbols), iconic (language, map symbols for topographic maps and drawings of physiographic features), and enactive (field trip with map and symbol sheets).	All three treatments showed significant gains ($p < .05$) compared with control. Enactive treatment was superior to iconic on three subscales; iconic to total symbolic on total and direction subscales. Meaningful map instruction can be developed in any mode, but combination probably would be superior.
Stoltman and Goolsby 1973	3	Map exercises were interspersed into individualized reading and social studies program of six months' duration.	On map subtest, work-study skills of the experimental group showed significant gains ($p < .05$) over control for both black and white students. Systematic map exercises enhanced map skills.

2.3 Testing Specific Map Skills

2.3.1 Direction

Although knowledge of cardinal direction after instruction was found in four reports, Howe (1932) was the only author to report performance data on tests. Three of the reports indicated that when primary-level children were taught cardinal directions by using the sun rather than directions inside in relation to school objects, they could profit from such instruction. Although Howe demonstrated that, after instruction, first-grade posttest responses were 50 percent correct, he nevertheless recommended that drill in directions be given at the third-grade level. Gregg (1941), however, in test interviews with first- and second-grade children, found that a group of first-graders who had learned directions while playing a kindergarten cardinal-direction game gave more correct responses than second-graders who had not played such a game. Since Howe's instruction was provided intermittently over a ten-week period, his recommendation that direction drill should be given at the third-grade level does not mean that younger children should not be taught directions.

As does the testing of other geographical concepts, directional testing shows an increase in correct performance by grade level (Edwards 1953; Howe 1931 and 1932). However, even sixth-grade children in the upper-27-percent ability level make incorrect responses to directional items, probably because of inadequate training (Preston 1956). Inadequate preparation, Preston surmises, might be associated with teachers' lack of knowledge of directions. As Lord (1941) pointed out, one can hardly expect children to learn directions when the teacher does not understand them--a deficit exaggerated by the lack of correct procedures (Ridgley 1922). The concept of cardinal directions appears to be too abstract for the trainable and educable mentally retarded (Lanegran, Snowfield, and Laurent 1970), although this testing was done without prior instruction.

The most extensive investigation of knowledge of directions was conducted by Lord (1941), who used an ingenious series of four different tests with children from grades 5 through 8 in Ann Arbor, Michigan. The four testing conditions were (1) knowledge of cardinal directions, (2) location of cities by directional pointing and sketch map arrangement, (3) community

orientation to buildings, and (4) travel orientation. Among the contextual conditions important to the investigation were the following facts: 93 percent of the students had lived in the community three or more years; about 75 percent of them had had all of their geography instruction in the same school; window orientation in classrooms was primarily east-west, because of lighting conditions; geography texts in grades 4 and 5 made ample use of directions (326 times in grade 4 and 896 times in grade 5 with 80 exercises).

In the test of cardinal and intermediate direction, using a cardboard compass rose for group testing and a piano stool with 16 compass points, it was found that the percentage of correct responses by grade level was somewhat higher at the eighth grade than at the fifth grade, but there was no consistent pattern. By direction, performance on cardinal directions was somewhat better than on intermediate; by sex, boys had a 55 percent correct response rate and girls had 38 percent.

On the pointing test of city location using an imaginary map, nearby cities and distant cities each scored about 23 percent. Detroit, the largest nearby city, was pointed out correctly in 54 percent of the responses. It was noted that south-facing children had more difficulty than north-facing children. In locating by sketching 16 cities within ten miles, answers were classified as "map" if the top of the map was orientated north and as "space" if answers were described merely as being to the left or right of the observer without map orientation. The ratio of space answers to map answers was 2:1; however, 20 percent of the responses could not be classified as being in either category. Nearby cities were located in space, distant cities in terms of the map. Cities were placed on the map as they had been studied in classes; thus, if the map was not oriented properly by direction, city locations were incorrect. Girls tended to give somewhat more map answers than boys on this subtest.

Lord's third test required students to locate real places in Ann Arbor by using conventional directions. The correct responses of boys consistently exceeded those of girls on the following locating tasks: buildings (23 percent and 12 percent, respectively), streets and bridges (54 percent and 43 percent), direction when in theater (20 percent and

17 percent), and mapping well-known places (16 percent and 11 percent). Lord concluded that, notwithstanding the fact that their mean number of years of residence in Ann Arbor was nine years, the students had, for the most part, failed to arrange the location of city features in accordance with the traditional pattern of directions.

The fourth test, which used a smaller sample, involved the ability to maintain a sense of direction while traveling in an automobile. Two routes were utilized: the first was a circular route; the second, a route with right-angle turns, was devised after the first was found to be too difficult. The point of departure was the school. Before beginning the trip, directions were reviewed so that children knew their orientation on leaving school. Nevertheless, on the circular route test 50 percent of the children were already disoriented by the first stop; by the third stop, only 25 percent of the boys and 18 percent of the girls were correctly oriented. On the angular route performance was better, with 50 percent knowing directions after three stops. In spite of the fact that testing was intentionally done on a sunny day, few of the students made correct use of the sun to keep track of direction.

Lord concluded that children did not know how to find cardinal directions properly, partly as a consequence of inadequate training in using the sun for orientation. His subjects used two very inadequate guides to direction at any given time: certain locational reference points and their own body positions. The distance factor was related to two frames of reference: a space frame relative to the observer for nearby objects and a map frame for more-distant objects. Lord thought that his study demonstrated the need for more outdoor exercises in teaching cardinal directions because those in the text were insufficient--a thesis advanced by Ridgley (1922) almost 20 years earlier--and that such outdoor exercises should also require children to orient themselves from different directional points of view.

This review of literature indicates that some children can learn cardinal directions as early as kindergarten, but that a high proportion of children do not know directions, either theoretically or functionally, as late as the eighth grade--probably because of inadequate instruction.

It might be noted, however, that even in tests with Air Force cadets of college age, directional errors were found, although the proportion of correct responses was high in this select population (Hutter 1944; Clark and Malone 1954).

The theoretical explanation advanced by Trowbridge (1913) about methods of orientation and the learning of directions remains one of the most helpful, in spite of the fact that his use of the term *uncivilized* is no longer fashionable. Trowbridge described two systems: domicentric (using one's dwelling place as a point of reference to the neighborhood) and egocentric, or abstract (using the points of the compass). The former method of orientation is learned naturally but always depends on determinate object reference points. This system "is backward looking"; that is; it helps a child, man, or animal return home by "looking backward." As Trowbridge picturesquely wrote: "It is as if the living creature were attached by one very strong elastic thread of *definite* length" (1913, p. 890). In contrast, the kind of abstract orientation using the points of the compass that is acquired artificially by education makes it possible to look outward to the horizon in the direction of a given compass point. Because the erroneous imaginary maps made by children may persist into adulthood, according to Trowbridge, it is important to ensure that students are taught how to correctly use maps and the globe.

Direction does not appear to be a subject of contemporary emphasis in geographic teaching. The most recent article by Lanegran, Snowfield, and Laurent (1970) was primarily concerned with the performance of educable and trainable mentally retarded children; geographic direction was incidental. The last article based on testing normal school subjects in a geographic perspective was by Preston (1956), more than 20 years ago. If the number of articles about directional testing is any indication of the emphasis on this skill in geographic instruction, it is likely that current tests would show no gain and perhaps a decline in directional performance. The fact that children can learn simple geographic concepts at an early age is no assurance that they will acquire the requisite knowledge and skills to make use of those concepts at any age, either informally or through instruction.

2.3.2 Scale

Except for the study by Sorohan (1962), the scale studies listed involved testing performance without instruction (Beilin 1970; Chanakira 1978; Prior 1959; Hayes 1973; Towler 1968). On the basis of these studies, most authors tended to recommend postponement. Beilin claimed that her results invalidated the Rand McNally recommendations for scale sequence; however, Hayes later noted that while the Rand McNally suggestions were related to linear scale, Beilin's task called for estimating area as well as distance. Beilin found that less than half of the fifth-grade students passed half of the test, and thus recommended postponement of teaching about scale until the sixth grade. Towler, in a similar vein, noted that the concept of scale appeared to emerge at the fifth grade, for it was at this level that subjects were observed making visual or manual estimates of the proportionality relationships of objects to symbols. Towler thought this finding implied that scale should be taught in the seventh grade, but he did not rule out earlier instruction. Hayes found that linear scale was mastered at the fourth-grade level and areal scale at the sixth grade, according to a criterion score of 15 on a 20-item test.

In view of the fact that geography is not taught systematically until the fourth grade, it is not likely that many elementary-level children will have had much experience with map scale expressed as a line divided into specified intervals. Since the data on scales indicate that the children who were tested probably had not had the benefit of systematic scale instruction, these reviewers conclude that there is no evidence to support assumptions about what pupils might achieve under appropriate instruction. Postponing instruction does not seem to engender an ability to use scale: students in ninth-grade geography classes were unable to perform strip map scale tasks without instruction (Chanakira 1978).

2.3.3 Time

The acquisition of clock-time understanding has been a common subject of investigation in young children, as has that of chronological

time understanding in intermediate-age children. Neither of these topics, although both are related to geographic understanding, is a specific concept of geography; thus they have not been included in this review.

Only two investigations involving time which involved a geographic perspective were identified: Walker (1952) dealt with time-space concepts in second-grade children; Davis (1958, 1959, 1963) dealt with time zones in the upper-elementary grades. Both of these studies involved a pretest-posttest, experimental-control group design, and both found that pupils in the experimental group achieved significantly higher scores after instruction. Both investigators reached conclusions emphasizing early instead of delayed instruction.

Walker asserted that the most significant finding of her investigation was that "time-space concepts held by seven- and eight-year-old children can be enlarged by instruction to a greater degree than the average teacher realizes" (1952, p. 96). Davis concluded that the deferment-of-instruction theory for teaching time and space concepts needed revision. He asserted that the limits imposed by maturation were not rigid, and that they could by offset in part by deliberate instruction. In particular, Davis rejected Wesley's idea (1950) that time zones should not be taught until after the sixth grade, suggesting instead that such concepts as sphericity of the earth, rotation, direction, and earth-sun relations could in fact be taught earlier and that provision should be made for sequential instruction.

It is significant that both of these researchers, prior to the "early stimulation" push of the 1960s, reached similar conclusions: that many geographic concepts can be taught earlier, and that rigid grade-level assignments are not desirable. Davis especially emphasized the importance of teachers' having adequate and clear understandings of these concepts so that they can transmit them accurately to children.

Figure 3

TESTING SPECIFIC MAP SKILLS

Direction

Study and Date	Grade Level	Description of Study	Findings and/or Conclusions
Edwards 1953	4-6	Knowledge of cardinal directions, latitude, altitude, horizontal distance, and area on the basis of 14 tests and three of four texts. Reliability .95, Spearman-Brown.	Mean scores: grade 4, 48; grade 5, 51; grade 6, 68. No inferences nor conclusions drawn.
Gregg 1941	1,2	Interviews to assess children's knowledge of cardinal directions.	Correct responses: grade 1, less than half; grade 2, a little more than half. Children in first grade with prior training performed better than second-graders without training.
Howe 1931	K-6	Individually administered test of children's knowledge of cardinal directions and the sources of their conceptions about direction.	Grades K and 1 made more incorrect than correct responses; grades 3-6 got more right than wrong but had a large number of errors and wrong explanations; boys did better than girls.
Howe 1932	1-3	Assessment of children's ability to locate directions using a sun stick.	On posttest, the mean scores were 50% for grade 1, 75% for grade 2, and 82% for grade 3.
Lanegran, Snowfield, and Laurent 1970	EMR and TMR	Measurement of performance of educable and trainable mentally retarded children on tasks involving geographical direction.	No boys were able to orient themselves by cardinal directions; most of EMRs and half of TMRs had some notion of mental maps.
Lord 1941	5-8	Ability to use cardinal directions properly was assessed by four tests: (1) knowledge of cardinal directions, (2) location of cities by directional pointing and sketch map arrangement, (3) community orientation, (4) travel orientation.	Knowledge of directions was inadequate because of insufficient training; there was a need for outdoor directional exercises; teachers who do not know how to find directions by using the sun cannot teach.

Study and Date	Grade Level	Description of Study	Findings and/or Conclusions
Preston 1956	6	Comparison of performance of German and American sixth-graders on four-item cardinal-direction test translated from German.	Achievement of U.S. students exceeded that of German students on all four items. Among bright American students, mean scores ranged from 25% on sun to 78% on directional items. Students of both nationalities had insufficient teaching.
		Scale	
Beilin	K,2,5	Construction of building layout corresponding to smaller map on grid (map, buildings, and grid to scale).	Using a passing criterion of 66%, less than half of students in grade 5 passed test.
Chanakira	9	Map-drawing task--students were asked to draw a strip map to scale of a land-use traverse.	Students were unable to cope with scale task; special instruction in linear scale should be built into field treatment.
Hayes	2-6	Students used models of buildings and streets to demonstrate their understanding of areal scale and linear scale.	Linear scale was less complex than areal and was mastered at grade 4 (using criterion score of 15 of 20); areal scale was mastered at grade 6.
Prior	4-6	This test called for students to draw a map of a model village, reconstruct the model from their maps, and locate neighborhoods of cities on maps.	Students became aware of scale between the ages of nine and ten.
Sorohan	4-6	Mark two points on paper, place against scale in miles; distance read. Scale as a representative fraction.	The concept of scale was not mastered at any level.
Towler	1-6	Substitution of a map for a model farm; matching scale map cards ¼ size of model.	Concept of scale appeared to emerge at grade 5.

Time

Study and Date	Grade Level	Description of Study	Findings and/or Conclusions
Davis 1958, 1959, 1963	4-6	Time zones in relation to sphericity, rotation, direction, earth-sun relations, clock time. Curriculum required 30 minutes for 14 days over three weeks.	Achievement significant ($p < .05$) but grade differences persisted. Wesley's assertion that time zones be taught at sixth grade and after was rejected.
Walker 1952	2	Six-week unit; two each on moon, stars, sun.	Results showed gain of 30 ($p < .01$), in favor of experimental group. Time-space concepts can be enlarged through instruction.

2.4 Summary

This review of recent research in map testing and map teaching indicates that there is general agreement that children possess map abilities before instruction which have not been appropriately assessed by conventional means and that achievement in the use of maps in sophisticated geographic programs can be enhanced by using programs of systematic instruction.

Both testing and teaching studies suggest that close adherence to Piagetian-type developmental theory leads to the deferment of map teaching. Essentially, the studies validate the position taken by Rushdoony in 1971 that children's performance on conventional tests is no indication of what they might do if properly instructed.

The results obtained by using the various experimental curricula indicate that very young children have been successfully taught map skills which are normally introduced much later in the curriculum. Particularly impressive are the findings of the Clark University Place Perception Project and of Crabtree, both of which emphasize mapping in terms of spatial relations as a geographic core. In both cases, as in the other experimental curricula, the two key variables related to pupil success were the design of the curriculum and the preparation of the teacher. Children can hardly be expected to learn concepts and skills which their teachers have not mastered.

The map research of the past decade has been piecemeal; taken together, it does not constitute a systematic body of research. In view of the fact that most map research has been undertaken by graduate students working toward masters' and doctoral degrees and has lacked follow-up studies, it is not likely that the overall picture will improve. Although all such studies conclude with recommendations for further research, the investigators seldom follow through on what they advocate. There is nevertheless a sufficient corpus of experimental curricula and data for designing sequential programs of accelerated instruction in map skills.

3.0 CONCEPTUAL AND ANALYTIC PROCESSES

This section is mostly concerned with a review of tests of children's general knowledge in geography, a summary of Crabtree's 1968 and 1974 reports, and anecdotal accounts of how young children learn geography. A brief subsection discusses reading and geography, and another is devoted to the evaluation of a kindergarten unit from the Georgia Geography Curriculum Project. Figure 4 provides a tabular summary of the studies reviewed in Sections 3.1 and 3.2.

3.1 Testing Children's Knowledge in Geography

This section summarizes some of the tests which have been administered to ascertain children's knowledge of geography. Aside from map studies, which are reviewed in Section 2.0 of this paper, the studies fall into five categories: (1) general information possessed by children on entering school (Hall 1891, Probst 1931, Templin 1958); (2) knowledge before instruction by grade level (Grade 1--Mugge 1968, Huck 1955, Newgard 1962, Sheridan 1968; Grade 2--Lowry 1963; Grade 3--Kaltsounis 1961); (3) geographic knowledge (Bettis and Manson 1975; Lackey 1918); (4) geographic vocabulary (Eskridge 1939, Milburn 1972, Scott and Myers 1923); and (5) reading in geography (Wiese 1936).

The only categories that, on the surface, seem to be related to what children *can* learn are the knowledge-before-instruction tests and the pre-school tests which indicate the conceptions--and misconceptions--of young learners. Vocabulary studies are also extensively treated, however, because they give some insight into the process of concept formation and causes of concept difficulties. In spite of the fact that the *Iowa Test of Basic Skills* is extensively used in school testing programs, there does not appear to have been an analysis of the *ITBS* since Rogers's 1935 dissertation. The results of the *ITBS* map subtest would appear to provide needed longitudinal information about the acquisition of map skills.

3.1.1 Knowledge on Entering School

One of the ways of ascertaining children's readiness for instruction

is to ascertain their level of general information prior to instruction. One of the earliest of such tests was devised by the noted psychologist G. Stanley Hall and applied to kindergarten children in Boston in the early 1880s. Hall's report referred to other tests--one as early as 1869 in Berlin--which measured the general information of children at kindergarten level (Hall 1891). Much of Hall's work, like that of Milburn (1972) almost a century later, focuses on children's lack of understanding of words that adults and teachers take for granted. Many examples of the delightful quotes that result from children's misconceptions--for example, that butter comes from butterflies--are found in Hall's article. But what he emphasized then, in noting the differences in understanding between urban and rural children, is that because the environments and experiences of children differ each child's understanding of the world will be different.

In one of the most comprehensive studies ever conducted of the general information level of kindergarten children, Probst (1931) devised a 132-item test consisting of two forms. The score range on Form A was from 15 to 55 and the range on Form B was from 14 to 52; each form had 66 items. The combined mean score for the 132 concepts was 71.6. The data were analyzed on the basis of the six-category *Barr Scale for Occupational Intelligence* and by sex. Boys had a mean knowledge of ten more concepts than girls had, and children from the upper half of the industrial classification exceeded those in the lower half--a class difference emphasized by Havighurst (1953).

The Probst test is of significance to geographers because the items were grouped into eleven categories, eight of which contained items related to geography. While the knowledge of the children was quite variable, the test might be interpreted as showing that many kindergarten children already possess a rudimentary knowledge base on which to build geographic instruction. The author, however, made no recommendations for instruction or curriculum.

In a 1954 replication by Templin, the Probst test was administered to a sample similar with respect to sex and socioeconomic status. Notwithstanding the changes in locale and time, the entire Probst battery was given. However, substitute questions were given to a smaller sample to offset the inappropriateness of some test items. The mean scores on

Templin's replication were significantly lower than Probst's combined mean of 71.6--58.3 on the regular test and 63.2 on the modified test. As did Probst, Templin found that boys consistently scored higher than girls, and that the socioeconomic variable favored the upper categories; however, in Templin's replication these differences were less pronounced.

Templin, unlike Probst, attempted a qualitative analysis of the test items. She emphasized the importance of the test environment, observing that "an identical question may not mean the same merely because of the time and place it was asked" (1958, p. 94). On the whole, she concluded that the qualitative responses yielded by the Probst replication were similar to those obtained in the original study, although there had been a decline in mean score. In both, children used clang associations (a carpenter lays carpets) and concreteness (What time is it at noon? Time for lunch), and their answers reflected many aspects of the specific environment in which they lived. The Templin study, however, tended to indicate some improvement in the responses of children in the lower socioeconomic strata--a finding which might have been more pronounced had the sample been representative of the population rather a replica of Probst's sample. The fact that her replication showed smaller differences by sex and socioeconomic status was interpreted by Templin as indicating that there were more similarities in the environmental stimulation of children in 1954.

Of particular interest to geographers is the fact that the children in the Templin study appeared to be more aware of the world, as illustrated by their responses to the question "What large city is closest to Minneapolis?" While the percentage of correct responses was about the same in both studies, the incorrect responses in the Templin study included cities in three states other then Minnesota and two foreign countries. After analyzing the personal explanations of respondents, Templin attributed this apparent increase in world awareness not to television but to the greater mobility of adults, friends, and relatives with whom the children had come in contact.

3.1.2 Knowledge Before Instruction by Grade Level

One emphasis in testing during recent years has stemmed from the

assumption that children entering a particular grade might have mastered many of the concepts being taught. Repetition of what they already know, some researchers believe, not only is boring for children but actually leads them to develop attitudinal sets that are not favorable to learning new material (Kaltsounis 1961). Among the studies that emphasized measuring knowledge before instruction were those of Huck (1955), Kaltsounis (1961), Lowry (1963), Mugge (1968), Newgard (1962), and Sheridan (1968). Most of these investigators tended to be optimistic; they emphasized identifying a knowledge base on which children's school learning can be extended and interpreted their results to suggest that young children can learn more content, especially in the primary grades.

One exception is Mugge, who tended to emphasize children's lack of knowledge. Much of Mugge's criticism (1968) was based on the inability of first-graders to conceptualize a hierarchy comprising *street, city, state,* and *country;* this was perhaps an unduly pessimistic appraisal because, while young children hear all these terms and are aware of them, beginning first-graders usually have not been exposed to instruction in political geography. A somewhat mediating position was taken by Sheridan (1968), who pointed out the need for children to have more direct contact with the physical environment in order to destroy misconceptions. Sheridan recommended that awareness of physical phenomena be used as a starting point for instruction and cautioned against assuming, merely on the basis of word recognition, that children entering first grade understand a concept--a common caveat in elementary literature on concept learning.

Lack of consistency in test items, conditions of testing, standards of test interpretation, and other test variables makes it impossible to assess the quality of the knowledge-before-instruction studies. Moreover, as was discussed in Section 1.0 of this paper, researchers have different notions of the concept of readiness. For example, take two investigators in the same geographic area: Crabtree at the University of California at Los Angeles and Mugge at California State University, Long Beach. While Crabtree was devising instructional programs in geography on the basis of the assumption that children could learn more in sequential programs of instruction, Mugge was collecting evidence which she interpreted in a more

cautionary vein and questioning the precociosity of today's children. Such differences appear to reflect basic philosophic disagreements about early childhood education which are related to values. Such differences are not amenable to resolution by experimentation.

3.1.3 Geographic Knowledge

In both number of test items (216) and number of subjects (more than 1,600), Lackey's 1918 investigation of knowledge of general geography has not been exceeded. Lackey's primary intent was to provide performance norms against which geographic achievement could be measured. For example, he reported that a normal fourth-grade pupil should be expected to correctly answer only 34 percent of the items, while a seventh-grader should be able to answer 73 percent of the questions. About half the questions required independent thought; the others required some memory of the content of six textbooks characteristic of the period.

The most recent extensive general testing of geographic knowledge was undertaken by Bettis and Manson (1975), who developed the 50-item *Michigan Elementary Geography Test (MEGT)* to test the geographic literacy of a 1-percent sample of Michigan fifth-grade students. The *MEGT* was designed to assess nine different objectives, with items distributed among three categories (physical geography, human geography, and geographic skills) at two process levels--remembering and understanding. On a sample of 12 items, the percentage of students making incorrect responses ranged from 45 to 84. The investigators found that questions based on physical geography were the most difficult, with performance slightly better on items selected from human geography. Although the students showed some proficiency in geographic skills, among them using map symbols, they were not proficient at calculating distance. Many understood changes in land use along the peripheries of expanding cities, but few associated city size and converging transportation routes with air, water, and noise pollution. A large number of students could not locate major cities, institutions, or industries in Michigan. Performance at the remembering level was higher than performance at the understanding level, a finding consistent with those of other tests. While the investigators cautioned that the *MEGT* was not compiled on the basis of existing instructional

programs or text analysis, they nevertheless concluded that "if geographic literacy is a goal for elementary education, substantial evidence now exists which indicates that that goal is not being attained" (Bettis and Manson 1975, p. 24).

3.1.4 Geographic Vocabulary

Two of the tests reviewed in this section were particularly focused on vocabulary. While knowledge of terms was implicit in most of the testing, the methods of scoring tests of geographic vocabulary were less ambiguous, normally requiring either correct usage or correct definition.

Both use and definition in a completion format were required by Scott and Myers (1923) to ascertain knowledge of common terms in history and geography in grades 5 through 8. The format required the student to give a functional response to an item and then, after several intervening items, to give a definition; for example, "Name an explorer. . . . What is an explorer?" (Today this format might be described as example-rule testing.) Scott and Myers found that conceptual mastery (defined as the ability to define and explain terms) increased with grade level, and that the number of incorrect definitions decreased with age. However, it was found that even in high school a large proportion of the students who could give a correct example could not give a correct definition. Undoubtedly, as Eskridge (1939) pointed out, in the absence of careful teaching the tendency to attach associated meanings rather than conceptional meanings to words persists over time.

Scott and Myers observed that the popularity of silent reading tests (they wrote in the early 1920s) tended to obscure the fact that many students who could use certain words in a contextual framework could not define them in an abstract manner. Today the multiple-choice discrimination test, which has become the standard for objective testing, probably obscures the extent to which children actually have knowledge of geographic terms; that is, today's children might reveal similar misconceptions about the terms *textile factory, granite, metal, stock raising,* and *cereals* if they were asked to write definitions. Scott and Myers suggested that the technique of first using a word and then asking children to define it was easily within the framework of classroom instruction.

Few of the studies of vocabulary and concept knowledge provide more than a quantitative report of the results at various grade levels and an elaboration of the many misconceptions of geographic understanding. However, Eskridge (1939) was not content merely to give a statement of the final test results; he sought to isolate some of the factors and principles related to growth in understanding geographic terms. His study, completed some 40 years ago, remains the most comprehensive and thoughtful of the geography vocabulary studies. Although Milburn (1972) used a larger study and open-ended responses resembling part of Eskridge's procedure, Milburn's explanations of the various causes of geographic misunderstanding are not as complete as those of Eskridge.

The reasons why Eskridge was able to provide more than a mere quantitative report were that he used four different types of tests and administered them to both individuals and groups; thus he was able to compare responses to the same test item under a number of different conditions. The four types of tests used were (1) essay, or open-ended, (2) multiple choice, (3) map identification, using two actual maps and two hypothetical maps, and (4) models, using such "concrete" materials as a political globe. Seventeen of the test items were common to three tests (multiple choice, map identification, and models).

Both the multiple-choice test and the essay test employed some special features. The multiple-choice format discouraged guessing by including, in addition to four foils, an "I don't know" option and an open-ended option ("I think it means . . . "). The fact that 21 of the 135 multiple-choice items did not have correct responses forced students to consider this option, an example of which was included in the practice items. Furthermore, the open-response answers had been collected prior to the preparation of the multiple-choice test; thus the foils included incorrect responses actually supplied by children rather than by the investigator. Both short ("Tell me what you think_____means") and extended ("Tell me as much as you can about _____") responses were solicited for the essay answers. The *National Intelligence Test,* Form A, Scale 1, provided a score of mental age to compare with performance on the achievement test by grade, chronological age, and sex. A supplementary 17-item multiple-choice test was administered to a second sample of 400 students.

As might be expected, the median scores reported by Eskridge showed a general increase by grade level for the 135-item multiple-choice test and the map-identification test; however, there was a decline on the models test in grades 5 and 6. The plotted curves showed different profiles of understanding; the greatest divergence was in the models test, on which seventh-grade scores barely exceeded fourth-grade scores. An analysis of performance on the 17 items common to three tests indicated that a child may know a term when it is presented in one test but not when it is presented in another. The author interpreted this finding to indicate that knowledge of a term is relative, not absolute, and that understanding must be thought of as developing in a number of dimensions rather than in a single dimension. An analysis of terms used in texts common to the four grade levels indicated that pupils had had some opportunity to learn meanings. However, achievement by grade varied markedly, and relative difficulties with meanings persisted over grades--a finding also reported by Milburn (1972, p. 115).

An analysis of the achievement data by three levels of mental age--low, middle, and high--indicated a tremendous overlap across grades. For example, the top scores of some fourth-graders were higher than those achieved by two-thirds of the fifth-graders and one-third of the sixth- and seventh-graders on the 135-item multiple-choice test. Similar overlapping was found in the map identification and models tests. Level of attainment was found to be qualitatively related to mental age. For example, of students in grade 4, none of the lowest third knew the meaning of the term *inland,* whereas 25 percent of the middle third and 42 percent of the highest third knew the term.

The "I think it means . . . " option was utilized by children for 114 items which did not require alternative responses (the correct responses having been given). Eskridge interpreted this finding as reflecting the desires of children to write their own responses. He also speculated that because some children had verbalized the meanings of the terms in their own ways, they either did not recognize the responses supplied in the test as being correct or preferred to construct explanations which better fit their own concepts. He thus concluded that comprehensive understanding of the meaning of a term emerges from verbalization.

Eskridge identified mental age as a fourth factor in vocabulary

knowledge by converting intelligence-quotient scores to mental-age equivalents. Data by grade and ability levels indicated that the highest mental-age group in grade 4 exceeded the performance of the lowest-ability groups in grades 6 and 7 on the multiple-choice and identification tests, even though the mean mental-age equivalent in the latter grades was higher than that of the grade 4 mean.

All in all, Eskridge identified six variable factors that he thought were related to growth in understanding: (1) amount of experience, (2) kind of experience, (3) level of geographic attainment, (4) ways in which meanings are verbalized, (5) mental age, and (6) sex. After identifying these factors, Eskridge outlined five characteristics associated with concept learning in geography:

1. Increase in the number of contexts in which meanings are recognized. Different test formats were used to measure comprehension of the same content--for example, multiple-choice tests and map-identification tests. In grade 7, 21 percent of the students responded correctly to common content items on both kinds of tests, as compared with 5 percent in grade 4.

2. Increase in general information. This criterion was applied by analyzing the answer to the open-ended essay questions. Analysis indicated that the responses of grade 7 children, as compared with the responses of those in grade 4, included a greater number and variety of ideas that could be categorized as "general information." This finding was interpreted to mean that growth in concept understanding occurs along with gains in general knowledge.

3. Substitution of basic meaning for associated meaning. A basic meaning is related to the essential properties of a concept; an associated meaning is an evocative and idiosyncratic interpretation--for example, "A native is a person who lives in a foreign country like Africa." A comparison of open-ended responses for grade 4 and grade 7 showed a decline in the use of associated meanings and an increase in the use of basic meanings. Data from the multiple-choice test corroborated this finding. Eskridge observed that these data showed (1) that children tend to learn associated meanings before they learn basic meanings and (2)

that growth in vocabulary understanding is limited when pupils retain associated meanings. He therefore concluded that growth in understanding is accompanied by substitution of basic meanings for associated meanings.

4. Substitution of comprehensive meaning for partial meaning. One example of a partial meaning would be the definition of trade as barter rather than as the buying and selling of goods. Data from several analyses showed that an increase in understanding results from the abandonment of a partial meaning for a more inclusive or abstract meaning.

5. Decrease in errors. Analysis of responses identified three common sources of confusion: (1) similarities in sound--as, for example, in the words *navigation* and *cultivation*--a phenomenon Milburn (1972) described as "homonymic"; (2) similarities in appearance--as, for example, in the the words *Antarctic* and *Arctic;* (3) similarities in structure and pattern--for example, *coal field* defined as if it were analogous to *corn field*.

Eskridge's study is particularly valuable in helping educators understand how different investigators can come to such different conclusions in evaluating the responses of young children, especially those obtained by means of oral interviews. If associated meanings are interpreted as acceptable, it is thus possible that an investigator will tend to emphasize the *extent* of children's knowledge, since associated meanings show at least some kind of awareness. However, if the investigator uses basic meanings as the criterion of conceptual understanding, he or she is likely to be much more restrictive in estimating the knowledge background of children prior to instruction.

The most recent study of knowledge of geographic vocabulary was completed in England by Milburn (1972). In cooperation with teachers from three primary and three secondary schools, Milburn compiled a list of 315 generic terms--for example, *country, tribe, race, people, animal, plant, river, sea,* and *ocean*. The 1,000 subjects tested were equally divided between primary and secondary students. Of the 147 primary terms, 110 described physical phenomena, and 96 were high-frequency terms as measured by standard word lists. The testing procedure was open-ended. ("Tell me something about this word. What does it mean to you?") Any essentially correct response was accepted.

Results indicated that primary students attempted to define 45 percent of the terms, while the secondary students attempted to define 86 percent of the terms. The percentage of correct responses increased from 8.8 percent in the first year of primary to 29.7 percent in the fourth primary year; secondary correct responses increased from 34 percent to 61 percent.

More interesting than the quantitative results were Milburn's conclusions: (1) the responses revealed many misconceptions, even about the most common terms--a finding similar to that of Scott and Myers (1923); (2) an accompanying study of the use of terms in English textbooks showed lack of uniformity in definitions, contradictions, and instances of incorrect and misleading usage--among them, the tendencies to give examples from one area only, leading to improper associations (fjords only in Norway, oases only in the Sahara), and to overemphasize regional and ideographic terms; (3) many types of errors were similar to those previously identified by Eskridge ("cape" was identified as an article of clothing and "ford" as a car). While verbal fluency increased in secondary students, correct word usage was not always accompanied by correct explanation (see Scott and Myers 1923).

As a result of this testing program, attempts at remediation were undertaken through systematic instruction in geographic vocabulary. Although gratifying improvement was seen in the primary grades, there was great resistance to clarifying concepts already covered, and secondary students showed no perceptible improvement. Thus Milburn concluded that it was all the more essential to clarify knowledge of geographic terms in the primary grades in order to ensure correct understanding. Since a child's ability to recognize geographical terms may differ markedly from his or her ability to explain them, Milburn believed that it was important to develop vocabulary in a systematic manner. His comments seem particularly pertinent because he is one of the few writers in recent years to have identified concepts with words and to associate mastery of geography with knowledge of geographical vocabulary. Milburn concluded: "The acquisition of concepts and active vocabulary are complementary aspects of the process of intellectual

development" (1972, p. 119).

3.1.5 Reading in Geography

One detailed study of reading in relation to geography understanding was conducted at the fourth-grade level. In 1936 Wiese, under the direction of Ernest Horn, used pencil-and-paper pretests and posttests in conjunction with oral interviews to examine the extent of students' geographic comprehension. The test items were based on passages from the students' fourth-grade text, *Our Neighbors Near and Far* (American Book Co., 1933). The IQ mean of the 37 children was 111 on the *Otis Primary Scale,* Form A, and the mean reading level was 45 on the *Sangren Woody Reading Test.* Oral interviews after the posttest were used to obtain more information about the students' understanding of the material. The responses of the children were stenotyped and transcribed.

Wiese concluded from the oral interviews that the interpretations which the children gave to the words, phrases, and sentences in the reading material varied to such an extent that no prediction could be made as to what understandings a given group of children would obtain from using the text. The caveat Wiese offered in 1936 undoubtedly remains appropriate: "If the type of material used in this study continues to be given children who are just being introduced to geography, it will be imperative that the teachers supplement it with many explanations and real experiences in order to help clarify the children's understanding" (1936, p. 64). Thus, the fact that children can read material and give appropriate answers to set questions does not mean that they have assimilated the material operationally; cumulative experiences and additional explanation are also required.

3.1.6 Summary

Tests in geography indicate that children enter school with varying amounts of geographic information and knowledge, intermingled with misconceptions. Whether the extent of knowledge before instruction is interpreted favorably or unfavorably appears to depend on one's philosophical orientation about the nature of early learning. However, it is probable that most investigators who undertake such studies do so because they

believe that preschool and primary children are being deprived of the content necessary to stimulate their intellectual development. Such tests reflect the knowledge gained from experiences in and out of school; they do not indicate what children *can* learn in programs of geographic instruction. However, they do indicate that children have a cognitive awareness of many phenomena--an awareness that might be used as a basis for a program of instruction, especially one involving both direct contact with the environment and explanations to clarify understanding.

The vocabulary studies indicate that, even in the upper-elementary grades, children have many misconceptions even when they are able to use words functionally. Eskridge's analysis is particularly helpful in understanding the different gradations of meaning and the ways in which children learn as they move from associated meanings to basic meanings. There is general agreement that children should receive systematic geographic vocabulary instruction at an early age.

Children in geography classes are expected to learn not only generic concepts, principles, and generalizations but also a great number of specific facts about specific places. One's concept of a particular place, large or small, is a composite of many different factors. While emphasis of spatial relationships has characterized some geography departments in recent years, this emphasis is merely an incidental strand in introductory college geography texts and is almost unknown in the social studies texts used by elementary children in the United States. Most of these texts still reflect a descriptive approach toward people and places; as a result, although children may indeed learn a tremendous number of facts, concepts, and generalizations, their views of the world may be lacking in sophistication.

These reviewers believe that tests designed to measure children's geographical knowledge may in fact be poor indicators of what children *can* learn, especially when (as is commonly the case) such tests are interpreted to show how poorly children actually perform. For example, Bettis and Manson (1975) emphasized the high percentage of items that were missed by most students. To suggest that another approach is needed toward estimating both the quantity and the quality of children's learning is not to

imply that we do not need better instruction in geography. However, we may be unwittingly underestimating the accomplishments of unselected populations in measurements of learning which are essentially verbal.

Figure 4

CHILDREN'S KNOWLEDGE IN GEOGRAPHY

Knowledge on Entering School

Study and Date	Grade Level	Description of Study	Findings and/or Conclusions
Hall 1891	K	Tested general information possessed by kindergartners.	Children had many misconceptions about their natural environment. Knowledge was related to experience.
Probst 1931	K	Comprehensive 132-item general information test consisting of two forms. Data were analyzed by sex and demography.	Mean on 132 concepts was 71.6. Boys did better than girls. Most kindergartners possess a rudimentary geographic knowledge base.
Templin 1958	K	Replication of Probst test, modified with respect to temporal and locational items.	Mean scores were lower than Probst's; sex and socioeconomic differences were less pronounced. Importance of test environment was emphasized.

Knowledge Before Instruction by Grade Level

Eskridge 1939	4-7	Vocabulary test of same items was given to 800 students in four test formats: multiple-choice, open-ended, maps (hypothetical and real), and concrete material.	Knowledge was affected by amount and kinds of experience. Ways in which meanings were verbalized varied by mental age and sex. Growth proceeds in five different ways.
Milburn 1972	2-6	A 147-item open-response test (about 110 of which were physical) was given to 500 elementary students in England. Oral responses were recorded in first two grades.	Ability to define terms increases with grade; students used many terms for which they lacked precise meaning.

Study and Date	Grade Level	Description of Study	Findings and/or Conclusions
Mugge 1968	1	Oral interview technique using geography questions taken from 1962 doctoral study.	Average child responded acceptably to 25% of questions; 19% to those on geography. First-graders only learn single concept classification. Maturity level must precede concept formation.
Newgard 1962	1	Students were given a 35-item oral interview about science and social studies (Earth's surface, rockets and satellites, Earth-sun relationships, seasons, work knowledge).	Results showed tremendous variation in amount and depth of knowledge. Map and globe skill training should begin earlier. Conclusions appear to favor more structured readiness programs.
Sheridan 1968	1	Identification test of 30 items about physical geography concepts was given to 55 students.	Students showed a partial awareness of many concepts but lacked knowledge of concepts beyond immediate environment. They earned higher scores on oral test but still showed misconceptions.
		Geographic Vocabulary	
Huck 1955	1	Interview; children were asked 3 questions each about 75 concepts designed to test knowledge entering grade 1.	Children come to first grade with extensive knowledge about their environment. Teachers need to recognize and build on this knowledge base.
Kaltsounis 1961	3	This 60-item test measured knowledge about food, clothing, shelter within categories of knowledge, comprehension, and application. Based on five random selected third-grade texts.	Mean score 31.48. At .05 level, students performed higher on application category than on knowledge or comprehension. IQ and prior knowledge were positively correlated. Children know more than teachers give them credit for knowing.

Reading in Geography

Study and Date	Grade Level	Description of Study	Findings and/or Conclusions
Wiese 1936	4	Oral interview measured comprehension of three passages from *Our Neighbors Near and Far;* also pre and posttests, reading test, IQ test.	Nature of reading material will require teachers to give many supplementary explanations and involve children in experiences. Teachers need to present geographical concepts in ways that can be understood.

3.2 Curriculum Evaluation Research: Crabtree

Charlotte Crabtree's comprehensive investigations of the efficacy of systematic instruction on young children's geographic learning (1968 and 1974) are among the least known of the research studies in geographic education. They are, however, among the most powerful of the studies dealing with young children's abilities to learn geographic concepts and skills. Her research with children in grades 1-3 demonstrates the possibilities for learning complex geographic concepts under conditions of rigourous instruction. In view of the significance of Crabtree's findings for this review, and because her research is not generally familiar to geographic educators, an extended synopsis of her two studies is provided in this subsection.

3.2.1 Purpose of Study

The central purpose of Crabtree's 1968 research was to investigate experimentally the effects of teaching a major conceptual system in geography to children in grades 1-3. Specifically, the study sought to determine whether children between the ages of six and eight could acquire an understanding of the concept of areal association and subsequently apply that concept in analyzing an unfamiliar geographic region.

According to Crabtree, areal association is a central concept for geographic analysis. A geographic region derives its character from associations between and among phenomena within the area. It is the study of these associations, in terms of their origins and their present relationships, that constitutes the focus of geographic inquiry. Areal associations may be analyzed as phenomena interrelated within functionally defined regions (accordant associations) or as phenomena changing over time (causal associations). These subsumed categories of areal association were developed in the Crabtree curriculum through a series of regional analyses of the greater Los Angeles urban complex.

Two curricula were developed and administered over 16 weeks to 12 classes in grades 1, 2, and 3. Both curricula employed the immediate Los Angeles urban environment as the focus for instruction in geographic concepts.

The two experimental curricula differed in their definitions of the structure of geography. Curriculum A derived objectives on the basis of

a definition of structure as the major organizing concepts of the discipline together with the analytic processes employed in geographic inquiry. Curriculum B derived objectives on the basis of a definition of structure as the major generalizations of the field.

Curriculum A was developed at three levels of increasing conceptual complexity to be introduced to grades 1, 2, and 3 respectively. Each level was designed to develop the concept of areal association. Two complementary processes were emphasized: identification of geographic features in a selected region and subsequent analysis of the associations between those features. Accordant, functional, and causal associations were developed in grades 1, 2, and 3 respectively.

The grade 1 Curriculum A focused on functional studies of the children's immediate urban neighborhood and its relationship to the surrounding urban complex. Emphasis was placed on the patterns of areal association among interrelated phenomena in the urban area.

The grade 2 Curriculum A introduced comparative studies of associations in the extended urban-industrial environment, with emphasis given to the patterns of association among geographic features functionally related between places. The categorical concept of functional association introduced the subsumed concepts of spatial interaction, distribution, change, and causality.

The grade 3 Curriculum A centered on historical studies of sequential occupance within the Los Angeles region, giving primary emphasis to those factors which account for changes over time in the distribution of geographic features. The concepts of time, change, and causality were included in the historical analyses.

Curriculum B defined the structure of geography as the core of geographic generalizations accepted by the professional geographer as the fundamental knowledge of the discipline. These generalizations were incorporated into the Curriculum B teaching objectives as the end products to be learned by the children. The geographic generalizations were to be inductively formulated by the children from data presented in the various instructional experiences. Unlike Curriculum A, which focused specifically on teaching geographic concepts, Curriculum B incorporated

the geographic generalizations into the normal structure of the social studies and did not prescribe a highly structured and sequenced series of lessons. Like Curriculum A, Curriculum B focused instruction in the three grade levels on accordant, functional, and causal associations within the Los Angeles urban-industrial environment.

At each grade level, three geographic generalizations were selected as the desired product of the children's inductive data analysis. Each generalization focused on the core concept of areal association in its reference to man's interaction with the physical and cultural landscape. For example:

Grade 1. Man constantly seeks to satisfy his needs for food, clothing, and shelter. In so doing, he attempts to adapt, shape, utilize, and exploit the earth.

Grade 2. To exist, man must utilize natural resources. Groups develop ways of adjusting to and controlling the environments in which they live.

Grade 3. The processes of production, exchange, distribution, and consumption of goods have a geographic orientation and vary in part with geographic influences. The nature of the organization of economic processes within an area (spatial organization) results from the kinds of resources, the stage of technology, and the sociopolitical attitudes of the population.

Obviously, children were not expected to formulate the generalizations in these words, but they were expected to develop from their observations the basic ideas included in each generalization. For example, to develop the grade 2 generalization given above, experiences were structured to lead children to observe that;

1. Agricultural areas develop where favorable soil, climate, and growing season make good crops possible.
2. Harbors (for incoming transport of fish and bananas to the wholesale market) developed when man found ways to build a breakwater and dredge a deep-enough channel.

3. Highways and railroads (used for transport of food sources) developed where man leveled or graded the land and where mountain passes of the coastal strand allowed access to Santa Monica.

Both curricula were presented to students over a 16-week period with 50 minutes of instruction per day. Both curricula resulted in significant learning of the concept of areal association. However, since the instructional procedures were specified only for Curriculum A, the remaining analysis is restricted to that program.

3.2.2 Instructional Program

At each of the three grade levels, Curriculum A attempted to conform to the characteristics of good organizing studies or centers as identified by Goodlad (1966). These characteristics included (1) provision of a variety of learning experiences meeting the interests and capabilities of the individual student, (2) opportunities for achievement of multiple instructional objectives, (3) opportunities for practice in the desired behaviors, and (4) opportunities for intellectual, social, geographic, and chronological movement or continuity between lessons. A fifth desired characteristic was added to the list by Crabtree: opportunity to reinforce prior learnings and to provide for extension to subsequent instruction.

The instructional objectives of Curriculum A consisted of both conceptual and process elements. The conceptual, or substantive, components were developed from the organizing concept of areal association. The process, or behavioral, elements were derived from the following fundamental analytic processes of geographic inquiry: (1) observing and acquiring data on forms and function within regions, (2) organizing and classifying geographic data, (3) analyzing patterns of accordance within regions, (4) analyzing patterns of interaction among regions, and (5) analyzing causal relationships among geographic phenomena. Instructional activities were sequenced to develop each of these analytic skills.

Observing and Acquiring Data. The abilities to observe, classify, and contrast are requisite to logical inquiry. The initial activities in the curriculum for each of the three grade levels focused directly on these skills through the use of field-study trips, scale models, maps, and air photos. At each grade level, field-study trips were the initial

data-gathering activities for the children. Walking trips into the surrounding residential neighborhood were designed to teach children to observe relevant geographic features in the urban complex. Later field trips extended to local commercial areas, the central business district, industrial areas, and the harbor. The field trips were supplemented by prior study of maps and aerial photos which directed the children's attention to the routes to be taken and the features to be observed, During each study trip, a large undeveloped map was taped to the sidewalk, permitting the children to record relevant features observed in the immediate landscape. Air photos were also made available during the trips so children could verify changes in the landscape.

Subsequent to each field study, children were involved in a classroom analysis of scale models of the region visited. A large scale model (1:300), which represented from six to eight city blocks and was equipped with buildings and vehicles, permitted children to reproduce the spatial layout of the area just visited through simulation and dramatic play. A smaller scale model, an acetate-overlay map system (used to develop the street system), and desk maps were also used during the post-trip analyses. As a group, the scale models, acetate-overlay maps, air photos, and desk maps provided opportunities for children to experience different scales and increasing levels of symbolic complexity. In addition to reinforcing observational skills initiated in field study, these materials were used to develop the concepts of linear and coordinate relationships. As a result of this instructional program, children were observed to make substantial progress in recognizing spatial coordinate systems and in using those systems for identifying positions of relative location.

Organizing and Classifying Data. According to Crabtree, children must be able to classify features by functional attribute prior to considering reasons for spatial patterns. Classification skills were developed first by lessons in the identification of separate forms or structures (e.g., residential, commercial, industrial) and subsequently by grouping those features by function (e.g., single-family residential neighborhood). Classification skills were first introduced by using three-dimensional models and later by using photos, pictorial maps, and air photographs. A

series of classification exercises proved to be effective in developing second-grade children's abilities to delineate functionally differentiated patterns in air photos.

Analyzing Patterns of Accordance Within Regions. After the classification exercises, children analyzed patterns of accordance and interrelationship of geographic features within a region. Scale models, acetate-overlay maps, and air photos were sequentially used to introduce patterns of association. Such patterns included, at the simplest levels, large supermarkets with their adjacent parking lots and, at a more-complex level, a brick-making plant located near accessible natural resources and subject to zoning laws.

Analyzing Patterns of Interaction Between Regions. Masking tape placed on the classroom floor was used to link scale models of different but adjacent regions (e.g., a residential area and the central business district), permitting the children to move model vehicles between the different areas. Acetate-overlay maps which reproduced the interchange systems developed with the models were used to increase the level of symbolic abstraction. Mapping exercises provided further reinforcement in analyzing patterns of spatial interaction in response to stories read orally by the teacher. In addition to patterns of circulation, patterns of relationship were developed (e.g., relationships between rivers and rock-mining operations and between harbor resources, markets, and transportation routes).

Analyzing Causal Relationships. Causal analysis was introduced only with grades 2 and 3. In grade 2, causal relationships were studied by considering the possible effects of construction of a proposed causeway across the bay. Observations from field-study trips and from analysis of air photos led to recognition of the effects of present man-made structures, for example a breakwater. By analyzing the known consequences of previous development, children were encouraged to predict the consequences of the proposed project.

Summary. Crabtree's instructional program progressed through a sequence of regional analyses, moving from (1) the children's residential neighborhood to (2) the commercial center serving their neighborhood to

(3) the local industrial region and its suppliers to (4) the local harbor. Each geographic extension included examination of the circulation patterns which connected the various regions. The regional studies were field-based, providing children with a variety of learning experiences and reinforcement of prior learnings at increasingly complex levels of analysis.

3.2.3 Results of the Instruction

The impact of this highly structured, sequential instruction in geography was assessed by asking students a series of questions keyed to each learning objective. Questions were differentiated at each grade level to include three levels of cognitive performance: (1) knowledge of geographic phenomena and functions, (2) comprehension of the concept of areal association, and (3) ability to apply the concept of areal association to analysis of unfamiliar geographic regions. Test questions were also differentiated by three levels of symbolic complexity: (1) highly pictorial photo items, (2) symbolic items at different scales and perspectives, and (3) air photo items.

The following examples are representative of the items used to assess the geographic learnings at different levels of cognitive performance and symbolic abstraction.

Grade 1. "Look at row 3. It shows an APARTMENT, a RAILROAD SIDING, a SUPERMARKET, a FACTORY. Draw a line on the *commercial* place."

Grade 2. (Student is provided with a contour map with data about latitude, wind direction, and elevations.)

"Find the place on your map where you would probably find the heaviest rainfall. Is it place 1, place 3, place 5, or place 8? Circle the correct answer on line 5 of your answer sheet."

Grade 3. "This is a map of a neighborhood that is going to change. A new freeway will soon be built through this neighborhood. The brown lines mark the freeway. The brown arrows mark the ramps where cars will get on and off the freeway.

"After the freeway is finished, one street will be much busier than it is now. Find that street. Is it the red street? Is it the green street?

Is it the blue street? Is it the orange street?
Mark the street that will be busier on line 1."

Following 16 weeks of instruction, the children's performance on the criterion test was impressive. At each cognitive level and across levels of symbolic abstraction, the students in all grades made substantial gains from their pretest scores (see table below).

MEAN SCORES ON CRITERION TEST

	Grade		
	1	2	3
No. of items	84	102	72
Pretest X	21.5	25.4	14.9
Posttest X	63	90	41.8

Posttest achievement was substantially above chance scores, with children in grades 1, 2, and 3 responding correctly to 75 percent, 87 percent, and 58 percent of the items respectively.

These scores demonstrate that children between six and eight years of age *can* learn a central concept system of geography and subsequently apply it in analyzing unfamiliar geographic regions.

3.2.4 Sequencing Geographic Skills

A second study by Crabtree (1974) examined the appropriateness of the sequencing of skills developed in the 1968 research. That sequence was founded on the premise that student mastery of the basic analytic elements of geography would facilitate continued learning of higher-level concepts and processes. Work by Gagne (1970) and Taba, Levine, and Elzey (1964) had suggested that the intellectual processes required in the experimental geography curriculum were hierarchically ordered and that mastery of each capability facilitated students' learning of more-advanced principles and analytic skills. The hierarchical assumption was tested by Crabtree (1974) using the 1968 curriculum with grade 2 children.

Three classes of grade 2 children participated in the 16-week field-based study of the immediate and extended urban environment. The results obtained were in accordance with those from the 1968 research: children demonstrated significant and substantial learnings of the concept of areal association and were able to transfer their analytic skills to analysis

of unfamiliar geographic regions.

The primary focus of Crabtree's 1974 investigation was to verify the hypothesis that mastery of each higher-level analytic process was dependent on prior mastery of those analytic processes subordinate to it in the learning hierarchy. Using a mathematical model for hierarchical analysis (Murray 1971), Crabtree concluded that the sequence of skills developed in the experimental curriculum displayed the characteristics of a vertical scale. That is, mastery of the discrimination and classification skills needed to observe geographic features and order them into functionally defined regions was prerequisite to mastery of the concept of areal association. Comprehension of areal association was likewise prerequisite to the capabilities permitting the identification of patterns of accordance and spatial interaction within and between regions.

To a greater extent than any other research identified, these two investigations by Charlotte Crabtree provide systematic, valid evidence of young children's potential for learning geographic concepts, map-interpretation skills, and analytic processes. Crabtree demonstrated that when young children are active participants in a highly structured and sequential series of geographic inquiries, they *can* learn complex analytic processes and concepts of geography.

Additionally, Crabtree's research demonstrated that children can transfer that knowledge to the interpretation of complex geographic patterns of human occupance in urban landscapes. The concepts and analytic skills mastered by these elementary-school children are generally introduced, if at all, into curricula much later than grade 3. It is assumed by most educators that children as young as eight do not possess the developmental readiness necessary for learning such complex concepts and analytic processes. Crabtree demonstrated that with systematic, sequential instruction young children *can* and *will* develop the hierarchy of skills and processes needed for high-level geographic investigations.

3.3 Curriculum Evaluation Research: Georgia Geography Curriculum Project

Since 1967 the Geography Curriculum Project at the University of Georgia has been engaged in the development of systematic, conceptually based units

centered around conceptual themes in geography. These units, which are based on the curriculum approach known as structure of the discipline (Rice 1973), emphasize the learning of those general concepts from geography which facilitate the subsumption of subconcepts and integration of facts. The tone of the project work is essentially Ausubelian, emphasing reception in contrast to discovery learning, although various types of activities are suggested which provide for inductive learning. However, greater emphasis is given to transfer--the opportunity to apply in a new context previous learning and skills--than to discovery learning.

Since the project has no outside funding and staff work depends on the availability and productivity of doctoral students in geographic education at the University of Georgia, progress has been slow. Over the past ten years, however, the project has produced twelve different K-8 curriculum units, eight occasional papers, and twelve doctoral dissertations based on field tests. The field evaluations of these materials tested not only content but also the utility of certain learning theories for curriculum design in geography. Unfortunately, the emphasis in most of the dissertations was statistical design and analysis rather than on the interaction of young geography learners with the material, which is written at a conceptual and structural level far more complex than that which is typical of elementary social studies and geography texts.

In this section, only one Geography Curriculum Project study will be summarized--that of Imperatore's initial kindergarten-first grade unit, *Earth: Man's Home* (1968). (Although Imperatore developed two other units for primary grades, *Place and Environment* and *Resource and Production*, those units were never systematically field tested.) Steinbrink's fifth-grade-level *Comparative Rural Landscapes* (1970b) was the first of the Geography Curriculum Project materials to systematically develop a unit according to a particular learning theory, in this case Ausubel's advance organizer. *Changing Culture* (Clauson and Rice 1972) was developed for the Anthropology Curriculum Project, but uses processes of modernization within a region as the basis of organization. This study is cited by Stoltman and Steinbrink, in Manson and Ridd (1977), as an example of

teaching geography by exposition.

Among the other products of the project are two units on population geography, *Population Growth of Mexico and the United States* (Dale 1972) and *Black Population Distribution and Growth in the United States* (Pelletti 1973a), both of which made use of data from maps, charts, graphs, and other visual aids; a unit on urban geography, *Functions of Cities* (Jones 1974); and a unit on transportation geography, *Transportation and the Environment* (Fagan 1974). Three units on the historical geography of changing land use were completed by Laws (1978a, b, c): one for an urban area, *Peachtree Street, Atlanta;* one for a reclaimed agricultural area, *The Fens of England;* and one for a semiarid area, *The Back Lachlan District of Australia*. All seven of these units, with the exception of Dale's, were tested in the middle grades.

As is the case with most other experiments in geographic and social studies curriculum development, there has been no independent evaluation of the units developed by the Geography Curriculum Project. Results of the field tests indicate that children can handle systematic concepts in geography when these are taught in a structured manner. However, implementation becomes progressively more difficult with increasing grade level since students do not perceive the structured, systematic units, measured against the conventional pattern of regional studies, as constituting "geography." Implementation appears to be easier in the primary grades, where children have not acquired preconceptions about the process and content of geography instruction.

Imperatore, the first developer in the Geographer Curriculum Project, attempted to focus on a conceptual approach which would emphasize the distinctive geographic content of social studies instruction. His thesis (1971) was that although such geographic concepts as areal association, man-land relationships, resource utilization and technology, and regional distribution and interaction were implicit in much of social studies instruction, they could not be emphasized by the teacher nor understood by the children because they were not clearly organized and presented.

Imperatore saw the task of the curriculum developer in geography as that of fleshing out these concepts so that they could be understood

by both pupils and teachers. He challenged the expanding-environment theory on the basis of studies which showed children in the 1960s to have an increasing awareness of the world. Instead of emphasizing the immediate neighborhood, he began by developing a unit which would help children conceptualize the idea, taken from Ritter, that geography was the study of the earth as man's home. Hence the title of his kindergarten unit: *Earth: Man's Home*.

Imperatore's field test of the materials produced evidence that five- and six-year-old children are capable of learning a wide range of geographic concepts when they are given appropriate instruction. His lessons employed a Pestalozzian method of asking leading questions to draw students through the study and to the desired conclusions. The instructional materials consisted primarily of pictures that illustrated the concepts, which were introduced verbally by the teacher.

The concepts and ideas developed in Imperatore's curriculum were related to the categorical concept of habitat. Children were led to observe, for example, that:

1. Man lives on Earth.
2. Earth is a planet in the solar system.
3. Earth has mountains, hills, and plains.
4. Earth has various climates.
5. Man has created a cultural environment on Earth to meet his basic needs.
6. The cultural environment varies from place to place.
7. Man uses Earth to meet his basic needs in various activities, such as fishing, agriculture, and manufacturing.

The achievement of the kindergarten children was assessed by asking a series of picture identification and discrimination questions. Students were required to choose, from a series of three pictures, the one best exemplifying a concept verbally stated by the teacher. For example:

> "In the bottom row of pictures, mark an X on the picture that shows the highest level of technology."

Thirty-three picture identifications were included in the test. For the 268 children in the study, the pretest mean was 11.44, indicating performance at a chance level. The posttest responses showed a mean of 20.54--

well above chance, indicating that significant learning had taken place. As was demonstrated in Crabtree's research with elementary-school children, these kindergarten children were able to benefit from using relatively sophisticated conceptually oriented materials in geography.

Because no group of children in any school system has longitudinally studied the materials of the Georgia Geography Curriculum Project, no conclusions can be made about the sequential and accumulative impact of the units. (Crabtree pointed out that had her third-grade students been exposed to a systematic and sequential curriculum instead of a single 16-week unit, it is possible that even more significant levels of achievement would have been attained.) Thus, their potential for showing what children *can* learn in a longitudinal program of instruction remains to be tested. All that can be said of the Georgia project and other experimental units is that when curriculum developers and teachers have deliberately introduced higher levels of conceptual thinking to young children, the achievement is impressive.

3.4 Anecdotal Accounts of Geography for Young Learners

The possibility of introducing geography to young learners has long fascinated educators because the environment--both physical and human--provides many opportunities for children to observe, obtain facts, and make inferences about relationships. This approach is not new--it was the basic pedagogy set forth in *Emile,* and since then it has been the most salient characteristic of natural (as opposed to didactic) methods of instruction. One of Pestalozzi's great contributions to education was his idea that learning could take place in groups, not merely in a one-to-one tutorial situation; in the early 19th century, learning from nature through observation (rather than from texts through reading) rapidly became the hallmark of the "new" education. Although natural education gave way to the object lesson and ultimately (after Dewey) to experience, these approaches shared the common pedagogy of bringing children into direct confrontation with the environment and using children's naive experiences to extend their conceptual understanding.

The fact that such procedures are universally recommended but seldom practiced has to do with the technique: it is a demanding one. Moreover,

since environments are endlessly varied, there can be no prescribed set of experiences for either teacher or pupil. As Mitchell (1934) pointed out, the first task of a geography teacher is to explore the environment--to know from firsthand experience the lay of the land, the relationship of topography to fields and roads and human employment. While it would be relatively easy to teach these things from a text, experience teaching is time-consuming in terms of both planning and execution. Not only must the logistics of the field trip be considered, the teacher must also ensure that the raw data of experiences are converted into meaning. The teacher must have a clear idea of instructional objectives and learning outcomes before children's encounters with nature and human activities can be converted into an understanding of geographic relationships.

Five anecdotal accounts are briefly mentioned in this section because they specifically describe geography learning from the natural environment. (Resumes of these accounts are included in the appendices.) Two of the five accounts--those of Isaacs (1930) and Mitchell (1934)--represent progressive education a half-century ago; two other accounts--those of Wann et al. (1962) and Robinson and Spodek (1965)--reflect the stimulation strand of preschool education in the 1960s. The fifth account, that of Kates and Katz (1977), reflects the recent work at Clark University in investigating the potential for geographic learning in the environmental impressions of young children.

3.4.1 Isaacs

Susan Isaacs worked at the Malting House School for Young Children at Cambridge, England, from 1925 to 1927. She was concerned with the processes of discovery, reasoning, and thought in young children. Isaacs early took issue with educators who advocated drawing conclusions about the abilities of young children from Piaget's clinical-task approach, and instead recommended using observational methods in a total learning environment. In particular, she was interested in the interaction of children with their natural environment, and she believed that this type of learning should be the basis on which to extend the thinking processes of children. Her *Intellectual Growth in Young Children* (1930), which

even today is one of the most optimistic of the treatises on the cognitive abilities of young children, has been quoted by those, such as Wann, who in the 1960s believed in the potential of using the kindergarten for intellectual growth and ignored by those who disagree with her conclusions about childhood education. To Isaacs, play, country excursions, weather observations, gardening--these were the foundations from which geography naturally energed (p. 48).

3.4.2 Mitchell

Lucy Sprague Mitchell, a contemporary of Isaacs, was an exponent of the experiential method of teaching. Mitchell's interest in the teaching of geography grew out of her experiences with young learners but did not stop there. She took a year off to work at the American Geographic Society, during which time she made extensive on-foot studies of the New York area--depicting on real-estate maps the phenomena she observed, from industrial buildings to apartment houses, and superimposing data compiled from other sources. Out of this experience she came to the conclusion that an essential element in geographic learning was mapmaking; she wanted children to be able to manipulate the phenomena they observed so that they could see the relationships between the myriad factors, both natural and man-made, which make up their environment. Long before the Clark University Place Perception Project was conceived, Mitchell was taking young children to the tops of tall buildings to give them better idea of map perspective and writing, "Airplane views are the easiest of maps because they are only extensions or variations of the familiar instead of being expressed in difficult symbols" (p. 45). Here, long before the work of Blaut and his colleagues, was a clear recognition of the maplike quality of aerial photographs and of the basis for their use--they are an extension of the familiar. Although--unlike Muir and Blaut (1970) and Hart (1971)--Mitchell evidently made no use of aerial photographs in map construction, she nevertheless concluded her monograph *Young Geographers* with the directive "Make maps!"--an activity which, she emphasized, helped children study relationships, not simply locations. Mitchell's ideas about geography, although they reflected a "stage" conception of child development, were congruent with the notion that young children could and should be taught

geography earlier. Her emphasis on map use is especially compatible with the current view of geography as a study of spatial relations.

3.4.3 Wann et al.

Wann et al. (1962) and Robinson and Spodek (1965) echoed Isaacs's belief that the basic learning of young children should grow out of encounters with their natural environment. Thus, they felt that the main task of early childhood educators was to ensure that children had ample environmental contacts which would arouse their curiosity. On the basis of these contacts, they argued, teachers could extend conceptual development. Wann especially criticized the standardization of equipment and realia that prevailed in preschools throughout the country (p. 5); as did Isaacs, he preferred naturalistic environments for educating children so that "how" and "why" questions would be elaborated. Like Isaacs, a generation earlier, Wann questioned the Piagetian tendency to place limits on the logical thinking potential of children. He supplied evidence to support his belief that children *want* to know and *can* learn more about the phenomena with which they come in contact, that they *want* to know and *can* learn more about the world beyond the here and now, and that they can be helped to expand their vocabularies to facilitate conceptualization.

3.4.4 Robinson and Spodek

Robinson and Spodek (1965) delivered a variation of the same message: that children can expand their intellectual development through planned contacts with the environment. However, they attempted to apply the structure-of-the-discipline approach to the education of young learners; in particular, they were concerned with studying concepts from the discipline of geography. The influence of Bruner's idea of a spiral curriculum (1960) was specifically acknowledged. They interpreted a spiral curriculum as one in which ideas are presented without a high degree of specificity, to be developed and enlarged upon later (Robinson and Spodek 1965, p. 12). Teaching for higher intellectual competence, according to Robinson and Spodek, was possible as early as kindergarten; however, in addition to providing experiences, teachers must focus on conceptual outcomes, be involved in language interaction with children, and otherwise actively guide the learning process.

3.4.5 Kates and Katz

Kates and Katz (1977) made nonteaching observations of the play of preschool children aged three to five in a day-care center. They reported, as do many adults who systematically observe the play of children, that they were surprised at the children's "sophistication of experience." Kates and Katz were especially impressed with the extent to which the children used play to replicate adult work and to acquire a better understanding of the world. They reported that, in contrast to Piaget's observations, their subjects knew "so much more so much earlier," and that their five-year-old subjects were giving the kinds of explanations that Piaget attributed to children between the ages of six and nine. For example, none of the five-year-olds observed by Kates and Katz described a cloud as a solid, and none invoked the deity to explain natural phenomena. Their report cites Deutsche (1937), who criticized (as did both Isaacs and Wann) Piaget's typology of causality as being vague and ill defined. Kates and Katz expressed the view that the interpretation of what a child means by his response is largely a matter of the investigator's personal judgment. In elaborating on the idea of the importance of this factor, Kates and Katz argued that the clinical approach used by Piaget might pose a problem common to all analyses of children's thought--"the questioner's bias" (p. 61). This view is particularly significant because they did not come to this conclusion from the perspective of developmental psychology. Dr. Kates is a professor of geography at Clark University; at the time of the study, Ms. Katz was a graduate student in geography. Thus, 40 years after Isaacs, we find geographers providing similar evidence that young children have the ability to understand basic geographic concepts.

These anecdotal accounts are not intended to represent a balanced sample of the views of early-childhood educators; admittedly, the sample is biased in favor of those who believe in extending the intellectual development of young children. None of these investigators was an advocate of didactic instruction--they all believed that the learning should grow out of direct experience with the natural environment. Instead of suggesting that experience alone was sufficient, however, Isaacs, Mitchell, Wann, and Robinson and Spodek were in agreement that experience needs to be complemented

by other strategies. Although Kates and Katz made no specific pedagogic recommendations, they provided anecdotal data from a geographic perspective to support the point of view that children's direct experiences need to be guided and interpreted if conceptual development is to be fostered.

4.0 CONCLUSIONS

What can children learn in geography? The evidence indicates, in brief, that children can learn what teachers set out to teach. Crabtree, Imperatore, Muir, and Hart are particularly noted for having developed programs of instruction in which advanced concepts and skills were introduced to children in grades K-3. Instead of being preoccupied with the literature that describes what children ought to learn, in terms of either presumed stages of development or cognitive hierarchies, these curriculum developers have shown that it is possible for younger learners to operate at a much higher conceptual and abstract level than would be inferred from any framework of readiness or antecedent learnings. It seems, on the whole, that Bruner's thesis (1960)--that children can be taught, in an intellectually honest fashion, something about almost anything--is essentially correct.

In making this appraisal, these reviewers recognize that Bruner subsequently recanted in "The Process of Education Revisited" (1971) and that they are referring to the Bruner of the 1960s, not the 1970s. Notwithstanding the shift from cognitive goals to affective goals in education during the 1960s, it is the conclusion of these reviewers that curriculum-evaluation studies undertaken from a cognitive framework support the idea that, given appropriate curriculum and instruction, the intellectual horizons of young learners can be expanded--thus it is not necessary to wait until grade 4 or 5 to introduce systematic conceptual learning and skills in the teaching of geography.

Along with this optimistic conclusion, however, a number of qualifications are in order. First, development and research in geographic education have not been systematic. The studies reviewed in this paper do not constitute an integrated body of geographic education data, but instead reflect the various researchers' individual assumptions about content and the nature of the learning process. Crabtree's areal association, Imperatore's "Earth as man's home," and Muir and Hart's aerial-photograph analysis of spatial relationships--even taken together, they would not constitute a complete primary curriculum in geography. However,

each of these studies suggests directions for further exploration.

Another characteristic of all these studies is that they are non-sequential--that is, none of them could qualify as a longitudinal study in which essentially the same population of learners has been involved year after year. Furthermore, most of the development and evaluation studies were short-term in nature. Muir's first-grade map-teaching project involved about nine hours of instruction distributed over three weeks. Crabtree's instructional sequence was the longest, requiring sixteen weeks.

Finally, very little attention was devoted in any of the studies to quality of instruction. Teachers who agree to participate in curriculum experiments are often those who are the most adaptable to new procedures and techniques, and their enthusiasm is often communicated to students. Thus it is often impossible to ascertain the extent to which the impact of innovation alone may have helped bring about positive results.

These qualifying remarks should not be interpreted to denigrate the substantial evidence that young children can learn more geography in the kindergarten and primary grades than is normally expected. In order to bring about this achievement, there appear to be two prerequisites. First, a teacher must sincerely believe that young children *can* learn more, if given the opportunity--that their cognitive learning can be accelerated, and that they can demonstrate a heightened consciousness of both geographic phenomena and the relationships between them. Second, the teacher must be able to create the conditions of learning, both formal and informal, which assure that learning objectives will be met. If their teachers have the will and capacity, it appears that young children *can* learn more. After all, aptitude is not demonstrated unless there is opportunity; potential remains unexpressed if there is no demand, no challenge. Performance is a reflection not only of raw genetic ability but also of cultural opportunity. In planning for the geography of tomorrow, teachers must give young geographers an opportunity to perform. Given appropriate conditions and guidance, they will perform.

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Appendix A

RUSHDOONY: SUGGESTED GRADATION OF MAP-READING SKILLS

(See Section 2.1)

Source: Haig A. Rushdoony, "A Child's Ability to Read Maps: Summary of the Research" (*Journal of Geography* 67:4 [April 1968]), pp. 213-222.

Preschool (Four-year-olds.)

1. Size and Shape. Two houses and two cows on plot of "land" (model).
2. Orientation and Direction. Using self as point of reference to home, school, theater, grocery.
3. Location. With regard to other nearby objects and with pictures.
4. Distance. Near, far.
5. Symbols on Maps and Globes. If they resemble real things.
6. Map Inferences. In relation to pictures.

Kindergarten (Concentration on skills 2 and 3 and on play and dramatic play situations.)

1. Size and Shape. Globe and room (regarding the Earth and continents).
2. Orientation and Direction. Route of ship (e.g., Mother went to Sweden and crossed the ocean).
3. Location. Places around the world (e.g., India, New York, Chicago, Japan, England, Florida, Bahamas, Scotland, Sweden, Hawaii); buildings, park, school, harbor.
4. Distance. From piers to ocean floor; known areas.
5. Symbols on Maps and Globes. Three-dimensional maps with symbols for land, water, places (globe); strips of gray paper for streets (on neighborhood map); flags for places lived; drawn "picture" of globe or Earth; letters for directions (SW).
6. Map Inferences. Referring to bodies of land and water.

Grade 1

1. Size and Shape. Room and things in a room; model of a farm.
2. Orientation and Direction. North on floor plan; cardinal and intermediate directions; street, road, intersection.
3. Location. Symbols on map (e.g., buildings, rivers, oceans, city or town, hills and mountains, level land); water and land (shown by color on globe).
4. Distance. In room, blocks; streets as grids.

5. Symbols on Maps and Globes. On commercial or class-made floor plan, neighborhood map, aerial view of community; for land and water (with color); for table, chairs, desks, doors, windows, buildings, streets or roads; for weather.

6. Map Inferences. From simple aerial view or neighborhood map.

Grade 2 (Good understanding of own geographic environment. Can relate somewhat realistically to outside environment--especially the intellectually above-average child.)

1. Size and Shape. Mountain, height of mountain, river and stream, ocean.

2. Orientation and Direction. Cardinal directions on globe, world map, neighborhood map, compass and shadows; several roads or streets (e.g., those which child takes to school and on trips with family).

3. Location. School, park, store, and other buildings; mountain, stream, bridge, United States, Japan, other countries known to child; ocean, island, hometown, where Eskimos live; awareness of the following places: Spain, Jamaica, Germany, India, France, China, Australia, Switzerland, Russia, Japan, Holland, places in the United States.

4. Distance. In terms of blocks: school to park, park to movies, home to park, ship versus jet (e.g., faster), Japan versus Granny's house, Earth to moon or sun.

5. Symbols on Maps and Globes. Picture maps (community, part of word, outer space); map of school (three-dimensional); symbolic map (region and features in it; e.g., street map of a central business district, residential or industrial zone, hypothetical area); on globe (ocean, island, city).

6. Map Inferences. Comparison of two distances, mountains with river, travel by ship or jet.

Grade 3

1. Size and Shape. No additional findings.

2. Orientation and Direction. On commercial map of region; on road map; trace route in town.

3. Location. Using street, road, or relief map; center of town; different seasons with use of latitudinal degrees; coastlines; hemispheres.

4. Distance. In miles (easier to compare rather than compute distance); town on road map (with road signs); continental map.

5. Symbols. Key (road or street map); relief, political, or physical map.

6. Map Inferences. Related to political units (street, town, city, country and continent); ways of living; density of population, rainfall, crops, livestock, resources (on a single map).

Grade 4

1. Size and shape. Comparison of five states (selecting smallest);

comparison of rivers (largest tributary).

2. Orientation and Direction. Cardinal directions (city, county); latitude and longitude.

3. Location. Several state boundaries (including river as a boundary); principal rivers, individual areas, coastal cities, capes, peninsulas, topography, climatic areas, poles.

4. Distance. Elevation; city farthest from the Equator.

5. Symbols. Using key in county or regional map; mountains; equator; poles; railroads; state and river boundaries; largest city; capital city; population and rainfall.

6. Map Inferences. Association of physical and cultural features (e.g., river and boundary, city on cape or peninsula); agricultural characteristics.

Grade 5

1. Size and Shape. No additional findings.

2. Orientation and Direction. Latitude; cardinal directions; intermediate directions; route of travel.

3. Location. River systems and bodies of water; land use, resources, soil, mineral deposits; growing season, precipitation, distribution of rainfall; vegetation, topology, mountains; population; political boundaries or divisions; railways, manufacturing areas; delta, peninsula, plateau, volcano.

4. Distance. Elevation; road maps; scale of miles (with use of three-dimensional models).

5. Symbols. Different population of cities and population density on United States and continental maps.

6. Map Inferences. (From combination of any two under skill 3.) Landscape features (especially by above-average youngsters); man's activities (population and economics and population and landscape factors) from two or more maps (especially by above-average children).

Grade 6

1. Size and Shape. Continents and oceans; land regions of hemispheres.

2. Orientation and Direction. (Cardinal and intermediate directions.) River flow; following routes; latitude and longitude.

3. Location. Use of latitude and longitude to locate cities, regions, rainfall regions, straits, peninsulas, wind belts, seasons.

4. Distance. Scale (graphic); elevation; comparison of distance and time.

5. Symbols. Population (e.g., density--people per square mile); rainfall data, population, graphic scale (of miles); map index and continental maps.

6. Inferences From Different Types of Maps. Regions, weather,

agricultural, transportation, relief; map projections.

Grade 7

1. Size and Shape. Continents, oceans.
2. Orientation and Direction. Latitude, longitude.
3. Location. Latitude, longitude, map index.
4. Distance. Scale.
5. Symbols. Map index.
6. Map Inferences. No additional findings.

Grade 8

1. Size and Shape. Continents, oceans.
2. Orientation and Direction. Latitude, longitude.
3. Location. Latitude, longitude.
4. Distance. Scale.
5. Symbols. No additional findings.
6. Map Inferences. No additional findings.

Appendix B

COX: SUGGESTED MAP SKILL SEQUENCE

(See Section 2.1)

Source: Carleton W. Cox, "Children's Map Reading Abilities With Large-Scale Urban Maps" (doctoral dissertation, University of Wisconsin at Madison, 1977), pp. 135-37. Duplicated as Publication no. 78-4, Geography Curriculum Project, University of Georgia, Athens, Ga., 1978.

Skill Objectives

Level A (ages 2-4)

1. Use of three-dimensional models to represent immediate environment.

2. Use of descriptive terms for both orientation and measurement (left-right, shorter-longer).

Level B (ages 4-6)

1. Comprehension of iconic or pictorial representations, including maps and air photos in vertical perspective.

2. Basic understanding of generalization; i.e., that maps are often discrete representations while air photos are continuous.

3. Use of letter-number grid systems.

4. Comparison of distances and areas at an ordinal level of measurement.

5. Understanding keys or legends which use shape and color as variables.

Level C (ages 6-8)

1. Using simple units of linear measurement, such as centimeters and meters.

2. Understanding of map scale; i.e., that "meters" on the map correspond to meters on the ground.

3. Comprehension of arbitrary point, line, and area symbols, both qualitative and quantitative.

4. Understanding of how size and color value are varied for quantitative symbolization on maps (in contrast to air photos).

5. Determining compass directions in the field and on large-scale maps and air photos.

Level D (ages 8-10)

1. Understanding relation of globe to small-scale maps through projection.

2. Understanding relationships of Earth to sun and moon, concepts of time, seasons.

3. Use of latitude-longitude grid system and Great Circle distances.

4. Relative location of continents, oceans, countries.

5. Use of small-scale general reference maps to locate countries, states, and cities.

Level E (ages 10-12)

1. Understanding of distortion on small-scale map projections.

2. Comparison of small-scale thematic maps to infer knowledge of a region.

3. Comprehension of complex symbolization used on statistical maps, such as isarithms.

4. Interpretation of contour lines to infer the topography of a region.

5. More-sophisticated appreciation for generalization and sources of map error.

Appendix C

HART: THIRD-GRADE MAP SKILLS FROM AERIAL PHOTOGRAPHS

(See Section 2.2)

Source: R.A. Hart, "Aerial Geography: An Experiment in Elementary Education" (master's thesis, Clark Universtiy, 1971). Duplicated for distribution as Place Perception Report no. 6 by Environmental Research Group, 529 Wabash Ave., Chicago 60605.

Phase 1

Photograph 1: "The School"

Identification of classrooms, schoolyards, streets.

Photograph 2: "The School District"

Location of familiar features of the neighborhood, beginning with a search for the children's homes; relative sizes, distances and scale; relative direction; boundary.

Photograph 3: "The Inner City"

Spatial Dimensions. Location; size, distance, and scale; direction.

Introductory Geographic Theory. Boundary-range-area-hierarchical; organization of the city.

Photograph 4: "The City"

Spatial Dimensions. Location; distance and scale.

Geographic Theory. Area (further work on the notions of range, accessibility, and boundary, leading to discrimination of areas and an understanding of the concept of centrality as an organizing principle revealed spatially); centrality (centripetal force of the city and the density gradient); geographical distributions (examples of distribution of amenities); industrial location.

Photograph 5: "City and Countryside"

A similar-scale photograph with the same goals but showing a different part of the city and the boundary of city with country.

Photograph 6: "Worcester and Surrounding Towns"

Spatial Dimensions. Location of already-familiar features.

Geographic Theory. Boundary (the discreteness of "places"); centrality (the city as a discrete unit with a centripetal force explaining the density gradient and the existence of a "downtown area); central place theory (an extension of the work with areas and subareas to hierarchy of settlements).

Photographs 7 and 8: "Worcester-Boston-Cape Cod"

These photographs supplement no. 6 in every way. They also show the location of Worcester in relation to Boston and the coast, and how places are linked to each other by transportation.

Appendix D

DAVIS: LEARNING ABOUT TIME ZONES

(See Section 2.3)

Source: O.L. Davis Jr., "Learning About Time Zones: An Experiment in the Development of Certain Time and Space Concepts" (unpublished doctoral dissertation, George Peabody College for Teachers, 1958), pp. 104-118 ("Daily Activities Diary" for grades 4, 5, and 6).

1. Globe.
2. Up/down.
3. Gravity.
4. Earth as model of globe.
5. Time by clock.
6. Cardinal directions (fourth-grade students knew east and figured out that shadows pointed west in the morning).
7. Directions at night using stars (reorientation in cardinal directions was necessary in sixth grade because of mistaken understanding derived from inaccurate street orientation in community).
8. Sphericity of Earth.
9. Rotation of Earth.
10. North Pole, South Pole.
11. Meridian (places on same meridian have same time).
12. A.m., p.m. (ante meridiem, post meridiem).
13. Longitude; difference between longitude and meridian.
14. Greenwich time and the prime meridian.
15. International date line.
16. Time differences: prime meridian, international date line, Nashville, Atlantic Coast, Pacific Coast.
17. Location of cities by meridian.
18. Network grid on globes and maps (children in grade 5 noted that degrees in meridians totaled 360).
19. Rotation of Earth through 15 degrees longitude in one hour.
20. Time zones in the United States.
21. Main meridians in the United States.

22. Historical reason for time zones. (Child asked in grade 4: At 9:00 in Nashville, what time is it at the North Pole? Use of Greenwich time at North and South poles.)

23. Meridians meet at poles. (Another question: How many meridians are there?)

24. Time difference of 12 hours between Greenwich and international date line.

25. Six hours' difference in every 90 degrees on longitude.

26. Places 15 degrees apart are one hour apart.

27. Identification of continents and major oceans.

28. Hours from Greenwich to designated cities east and west of prime meridian.

29. Advantages and disadvantages of Mercator projection.

30. Drawing of meridians 15 degrees apart on Mercator projection desk map.

31. Practice in using world time-zone map in telling time at different cities.

32. Time-completion task. (When it is 9:00 a.m. in Nashville, what time is it in Honolulu?)

33. The 24-hour clock.

34. Review of number of meridians.

35. Names of U.S. time zones, map work.

36. Time-zone boundaries and 11 U.S. cities.

37. Relationships of activities to differences in time zones.

38. Television and radio broadcast times and local viewing habits by time zone.

39. Question and explanation: Who first drew meridians on map?

40. Daylight saving time.

41. North polar projection, time on this map using the globe.

42. Review of east-west, north-south directions, using globe and north polar map.

43. Relationship of international date line to calendar.

Appendix E

IMPERATORE: *EARTH, MAN'S HOME*

Source: W.A. Imperatore, *Earth, Man's Home: A Beginning Geography Unit* (Athens, Ga.: Geography Curriculum Project, 1968).

Unit and Content for Grade Level 1

1. Where man lives.
2. Earth in the solar system.
3. Earth's position in the solar system; suitability as a habitat.
4. Shape of Earth.
5. Size of Earth.
6. Basic Earth information.
7. Surface of Earth.
8. Surface variability: basic landforms.
9. Surface variability: man and landforms.
10. Earth's climates: humid climate with four seasons.
11. Earth's climates: wet climate with no winter.
12. Earth's climates: dry climate areas.
13. Earth's climates: no summer.
14. Earth's climates: simplified Trewartha map.
15. Landforms, climate and man.
16. Cultural variability.
17. Recognizing elements of our cultural environment.
18. Man's needs.
19. Man's natural environment as a storehouse: man uses Earth.
20. Man uses Earth.
21. Technology.
22. Man uses Earth: three basic ways.
23. Man uses Earth: gathering.
24 Man uses Earth: agriculture.
25. Man uses Earth: manufacturing.
26. Man and his cultural environment.
27. Summary.

Appendix F

ISAACS: ANECDOTAL ACCOUNTS OF GEOGRAPHIC KNOWLEDGE IN YOUNG CHILDREN

(See Section 3.4.1)

Source: Susan Isaacs, *Intellectual Growth in Young Children* (London: Routledge and Kegan Paul, 1930).

Phenomenon	Knowledge of	Age	Page
Direction	A young boy brought a pencil with a compass on it to school. After asking what it was, another boy said, "That's a compass; the needle points to the north."	6	132
Direction	After seeing a picture of boats in a harbor, the following conversation took place: "Can you go all the way to China by boat?" "You can either go all the way by boat, or part by boat and part by train." "How do you know, have you been?"	4½	129
Ice	After finding some ice in a wheelbarrow, a child held two pieces together and they froze together. He knew that they "would be stuck."	3½	126
Location	A boy had to walk to someone's house. He had never been there before. Luckily, by locating the street in relation to other streets, he was able to find it.	5½	116
Location	The (English) children were able to understand how location was important by seeing that it was possible to go to London for the day but impossible to go to America or India for the day.	4½, 5	118
Location	After making some ships, the children talked about where ships would go. One boy said his was going to Cambridge.	5½	154
Map use	A pupil noticed that, on a homemade map, one location was not there, so he placed it on the map, tracing the exact distance from each road and corner.	5	115

Phenomenon	Knowledge of	Age	Page
Map use	A teacher stated that she was going on a bicycle trip. One student asked how she would know the way. Another stated, "When you come to the crossroads you will have to look at the map."	7, 8	37
Measurement	After seeing a plane fly overhead, a boy wondered how high it was. He thought maybe 100 inches until be measured the seesaw, which was 104 inches, and decided that the plane was five times higher than that.	5½	134
Mountains	After drawing a mountain on the floor with chalk, a child walked along the lines, saying, "I'm going up to the sky."	5	113
Natural beauty	A young boy made up some verse and suggested a game to be played with it. The verse was: "The beautiful snowy mountains; the sun and the moon and the stars; the sun melts the snow away; and then there are great waves on the sea, and the waves knock the small boats over."	5½	117
Physical appearance	Seeing the sun through mist, a girl said, "Look, Mummy, there's a sun wrapped up."	3½	357
Physical law	One boy demonstrated to a little girl that if you put water down one side of a U-tube, it will come out the other.	5½	153
Physical state	A very young boy knew that water placed outside in cold, frosty weather would freeze; also that snow set on a furnace would melt.	2	126
Physical state	A boy noticed that when something freezes, it changes physically: "It gets harder when it freezes--then it gets soft and then it gets hard again."	4½	128
Place	A young boy made a biplane, then ran outside and filled a pit with water. After flying the plane over the pit, he said, "It's flying over the Atlantic."	3½	119
Rain	Children watched the black clouds and stated, "It's going to rain."	2, 8	113

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Phenomenon	Knowledge of	Age	Page
Scientific law	Trying to pour water into U-tubes, children discovered that "if you keep your finger in one end of the tube, you can't pour water down into the other."	5½, 7½	136
Sun	After trying to stay outside in the bright sun, a boy decided to go in because "my eyes are too bright out here."	4	146
Sun	The sun was hidden by a cloud. When it came out again, a child remarked, "The sun's come out again . . . now it's warm."	4	113
Temperature	It was hot outside, and the children knew that putting ice in the water would make it colder than tap water.	2-8	126
Travel	Children knew that ships travel on water and that water surrounds the land. They knew that airplanes could fly around the world.	6, 6½	116
Water	After finding a hole in a tree and pouring water into it, children found that the water came out of a hole lower in the tree. Wondering if this could be done the other way around, one child said, "Not unless there is pressure behind it."	6	113
Wind	A child saw some bushes sway and was able to understand that the wind caused it.	3½	359

Appendix G

MITCHELL: IDEAS OF MAP DEVELOPMENT FROM *YOUNG GEOGRAPHERS*

Source: Lucy Sprague Mitchell, *Young Geographers,* reprint edition (New York: Basic Books, 1963).

Prerequisite Learning Before Working With Maps

--Space relationships in faraway and large-scale situations, both horizontal and vertical.

--Relationship of drainage to elevation.

--Relationship of soil to elevation (not developed).

--Relationship of human work to environment (not developed).

--Map projections, or distortions of Earth's surface due to imposing a spherical form on a flat surface.

Space Relationships

1. Use strip of blue oilcloth to depict rivers on which boats can navigate, other lines for railroad tracks.

2. Use blocks and other play devices to develop kinesthetic sense of relationship.

3. Perspective--trip to a high building, aerial photograph: "Airplane views are the easiest of maps because they are only extensions or variations of the familiar instead of being expressed in difficult symbols."

4. Use of large-scale maps on floor with realia--tool maps.

   a. Introduction of scale (7-year-olds).

   b. Orientation (and some drill); point is to improve the play.

5. Construction of demonstration and model maps, however crude, to get sense of elevation.

   a. Make maps of sheetrock cement.

   b. Make maps of putty.

   c. Sand table--modeling sand.

   d. In country, dig in the dirt.

   e. Make graphic relief maps for modeling.

   f. Have large photographs available.

   g. Use drawing conventions to make maps.

Relationship of Drainage to Elevation

1. See relief maps, models, playing in dirt, above.

2. Extend scope of play maps--use tool maps and not mere demonstration maps.

3. Emphasis on relief through feeling texture (drainage is relief in reverse terms; rainfall and drainage in relation to rivers).

4. Importance of relief for showing physical factors related to man and environment.

Map Projections

1. Begin with globe. (How is something located on a sphere?)

   a. Inductive emergence of concepts of arbitrary points from which to measure (Equator to prime meridian).

   b. Convenience of measuring in degrees.

2. Projections (work out with paper before studying maps).

   a. Daisy

   b. Polar projections (south and north).

   c. Equatorial (comparison of distortion of Greenland with that of South America).

   d. Goode's equal area projection.

   e. Mollweide's homolographic equal area projection.

   f. Two-hemisphere projection.

   g. Conice projections.

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Appendix H

MITCHELL: DEVELOPMENT OF GEOGRAPHY THINKING AND TOOLS, AGES 4-10

(See Section 3.4.2)

Source: Lucy Sprague Mitchell, *Young Geographers*, reprint edition (New York: Basic Books, 1963), pp. 19-21.

	4-5 years	5-6 years	7-8 years	9-10 years
Interests and observations	External moving objects (autos, animals, boats, trains). Sensual and motor impressions (train moves, whistle blows, soup is hot).	Functions of moving objects (train pulls cars). Relationships between objects and functions (train to track, station, freight).	Skills and techniques, still mostly in "here and now." Beginning of interest in long-ago and distant phenomena.	Techniques, adventure, mysteries. Distant and long-ago phenomena.
Orientation	General sense of direction on streets from home to school and other familiar places.	Familiar places crudely placed in space relations. Makes rough block-building maps.	Makes rough maps with crayons. Orientation begins in relation to distant and long-ago.	Ability to think of geographic abstractions; e.g., projection, sphere, and Equator.
Tools and methods of expression	Makes images in crayons and clay. Dramatic play extends to moving objects, often put into domestic setting. Symbols for image recall often have little representative value. Cooperative play begins.	Dramatic play much elaborated. Representative symbols more important. Cooperative play is elaborated.	Symbols of general ideas begin, still closely tied to direct images. Reads books and source material in map and chart form.	Symbols expressed in abstract forms with actual image recall.

	4-5 years	5-6 years	7-8 years	9-10 years
Curriculum implications	Trips extend to familiar streets. Orientation after trip. Widened exploration of living things. Indoor and outdoor block play. Clay. Crayons.	Motor memories still dominant. Use oilcloth for rivers, chalk for streets. Airplane views. Perspective maps. Trip to high building to see many things in their space relationships.	Use of compass. Pilot maps. Practice in scale and relief experiments. Out-of-door maps. Concept of erosion--rivers and sea-drainage--growth of living things conditioned by earth forces. Tool maps of oilcloth. Trips in connection with here and now. Photographs of faraway. Stories about faraway in which dramatic control is geographic: e.g., earthquake.	Big out-of-door map. Animal geography. Projections. Own free maps. Atlases. Source materials, historical and geographic. Use of globe.

Appendix I

WANN ET AL.: YOUNG CHILDREN'S EXPLANATION OF GEOGRAPHIC PHENOMENA

(See Section 3.4.3)

Source: K.D. Wann, M.S. Dorn, and E.A. Liddle, *Fostering Intellectual Development in Young Children* (New York: Teachers College Press, 1962).

Phenomenon	Knowledge of	Age	Page
Countries, names of	Some girls playing dress-up were telling where each would be from. They were able to describe something about France, Florida, Africa, New York, Mexico, Holland, Puerto Rico, and Jamaica.	5	26
Different places	A teacher noticed that whenever children wished to take a trip it was to a distant place, such as India, Japan, England, the Bahamas, Africa, Sweden, the North Pole, Hawaii.	5	123
Distance	After reading a book called *Very Far Away*, one child said, "Across the ocean is very far away."	4½	42
Distance	While playing "train," some (New York City) children decided to take a trip to California. One boy asked if it was nearer or farther than New Jersey? Another answered, "Farther, of course."	4	42
Location	After being shown a beach scene, children were asked to respond. Some answers were: Arabia, California, New York, warmth, heat, Nantucket, Jamaica, boats, Haiti, mountains.	3	44
Location	Another group of children of a lower social level was shown the same picture as above. Their responses were: swimming, trip, picnic, sand, Florida, Atlantic City, crocodiles, fish, monkeys.	5	45

Phenomenon	Knowledge of	Age	Page
Location	While talking about trips, a young girl decided she wanted to go to Mars. Asked where it was and what she would find there, she responded, "Up in the sky . . . stars."	3	46
Moon	A teacher asked a child what the dark patches on the moon were called. The child responded, "Craters," and proceeded to tell the teacher how they were formed.	5	41
Transportation	While playing "boat," one child remarked that he was in Florida, so no one could talk to him since he was far away. Another remarked, "We're in Paris. We had to take another boat to get here."	4	42
Weather	A child told her teacher that she had heard over the radio that it was going to get cold and slippery. When her teacher asked how, the child replied that the rain would freeze.	5	24
Weather	A young boy's description of a hurricane: "A hurricane is a 'faster' rain because it goes so fast."	5½	27
Weather	The following statements were made by two children looking at a book about the sky: "Water comes from the clouds." "Air ends up in the sky at the beginning of space. There's no water or air up there and you can't live there."	5	27
Weather	After announcing that he was "going to the North Pole," a young boy described it: "It's freezing cold up there."	4	41
Weather and climate	While discussing weather, one four-year-old made the statement "Water makes ice." Another said, "Snow is a pillow on the ice, It's different than water."	4	59

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Phenomenon	Knowledge of	Age	Page
Weather and climate	One girl knew that since Miami was far south, it was warm there.	4	46
Weather and climate	After being asked where snow comes from, a boy replied, "All the rain turns to snow when it is cold."	4	60
Weather and climate	A child remarked, "More snow, more snow! In the summer it doesn't snow. In the winter it snows a lot."	4	60
Weather and climate	A teacher asked a boy what clouds are made of. He answered, "Steam."	4	60
Weather and climate	Another child answered, "The hot-water smoke makes vapor, and clouds in the sky."	4	61
Weather and climate	After collecting some snow, the children put it near the radiator. They said: "It's warm here. My snow turned to water." "Santa Claus . . . makes snow." "No, that's God."	3	103
Weather and climate	One child was overheard to say about condensation, "You don't have to wipe up that water; it will evaporate."	4	130

Appendix J

ROBINSON AND SPODEK: GEOGRAPHIC CONCEPTS TAUGHT TO KINDERGARTEN CHILDREN

(See Section 3.4.4)

Source: Helen F. Robinson and Bernard Spodek, *New Directions in the Kindergarten* (New York: Teachers College Press, 1965).

New York as a Harbor: General Concepts

1. Man can understand the geographic aspects of a harbor by analyzing the following factors:

   a. Site (physical characteristics).

   b. Situation (relationship of the harbor to its service area).

   c. Facilities (what is needed in order for it to function as a harbor).

   d. Functions (interrelationships between the harbor and other aspects of the city).

2. Man is able to represent the world and its parts symbolically.

3. Man can place occurring events in a framework of chronological time.

4. Changes that have taken place in the harbor can be understood in relation to changes in technology and in the needs of people.

5. These changes can be understood in the framework of time and space.

New York as a Harbor: Specific Understandings

1. Manhattan is an island, completely surrounded by water.

2. Because it is an island, it is crowded. Buildings are high, and bridges and tunnels are needed for people to get on and off Manhattan.

3. People go to and from work in New York in different ways.

4. Ocean-going boats can enter the Port of New York alone, but they need tugboats to help them dock.

5. Even in winter boats can go in and out of New York.

6. Boats come from great distances to New York.

7. Many of the goods and people entering New York come by means of transportation other then boats.

8. Many of the goods and people entering New York by boat are transferred to other means of transportation and then leave the city.

9. There are many different kinds of boats.

10. Boats carry cargo and people.

11. Different boats perform different services.

12. Boats are different today than they were long ago.

13. A boat is a community. There are different jobs that different people do on boats.

14. Boats use special means of communication with each other and with the land.

15. Areas in the city can be located by distance and direction.

16. A picture can be drawn to represent different parts of the land. This picture, using scale, distance, and direction, is called a map.

17. Boats use maps (or charts) and compasses to travel on the ocean.

18. Tides in New York harbor cause the level of the water to rise and fall.

19. Boats dock on the shores of Manhattan and on opposite shores.

20. Time can be measured in many ways. We use time in understanding the long ago.

Map Concepts

1. New York City area, including harbor.
   a. Direction.
   b. Distance.
   c. Scale.
   d. Symbols (water, land).
   e. Navigation channels.
2. Mapping kindergarten classroom.
   a. Floor plans (difficulty in drawing from birds-eye view).
3. Block representation of geographic elements.
   a. Docks and warehouses along paper river following field trip.
4. World map (India)
   a. Artifacts from India.
   b. Pins marking where children have been.
   c. Pins marking origin of artifacts by country.
   d. Comparison of globe and flat maps.

The Neighborhood as a Community

1. Perspective and maps looking down on community from a tall building.
2. Use of cardinal directions (instead of "uptown" and "downtown").

3. Creation of microenvironment (paper streets and block buildings).

Return to New York Harbor

1. Large-scale map marked with symbols for places familiar to children (ferry depots, school, trip routes).

2. Slides for recall, discussion, and synthesis.

3. Floor plan of classroom (no increase in perspective, no formal drawing).

Appendix K

KATES AND KATZ: ANECDOTAL KNOWLEDGE OF PRESCHOOL CHILDREN

(See Section 3.4.5)

Source: Robert W. Kates and Cindi Katz, "The Hydrologic Cycle and the Wisdom of the Child" *(Geographical Review* 67:1 [January 1977], pp. 51-62).

Natural Phenomena

Stimulus: water poured into mound of sand, air blown into sand, mound bursts. "What did you make?" "We made a volcano."

Water

Stimulus: picture of tap, water drop, cloud. Children responded that water comes from a stream, is piped to house, comes up through pipes in wall to faucet, goes down the drain, runs under the street to the bottom of the hill and then into another pipe, then into the dirt where people use it for plants. No knowledge of reservoir, no connection between rain and tap water. Clouds and rain were associated. (Children conceived of two cycles, apparently, one dealing with drinking water and one with rain, but the two were not connected.) Five-year-olds' conceptions were better developed than those of three- and four-year-olds.

Uses of Resources (blocks, water, sand)

Uses by Children

Sand and water together: mountains, volcanoes, castles, buildings, people, messes, playing house (using mud to make pies, cakes, coffee).

Blocks: houses, buildings, people.

Water alone: soup, cleaning everything from dishes to cows, rivers.

Uses by Adults

Water: washing, drinking, cooking, sailing boats, watering plants, putting out fires, making paint.

Sand: limited adult use--sand to clean wood and keep steps from being slippery.

Blocks: adults don't use blocks, but do use wood.

Age differences: older children (five-year-olds) recognized a greater array of activities and possible resources. Actual play with resources was more creative than children described verbally.